MAUSAM, **55**, 4 (October 2004), 721-736

Weather in India

POST-MONSOON SEASON (October to December 2003)*

1. Introduction

During the post-monsoon season, two severe cyclonic storms (one over Arabian Sea during 12-15 November and the other over Bay of Bengal during 11-16 December) and two depressions had (both over the Bay of Bengal) formed. Excluding the Arabian Sea storm, all other systems made landfall and crossed Andhra coast. Tracks of these systems are shown in Fig. 1.

Southwest monsoon withdrew from the entire country on 15 October. Northeast monsoon rains commenced over Tamil Nadu, Kerala and adjoining states of Karnataka and Andhra Pradesh on 19 October, close to the normal date. Unlike the previous two years, there was a clear-cut demarcation between the withdrawal of southwest monsoon and the commencement of northeast monsoon rains over the southern peninsula. The northeast monsoon rainfall was *normal*† over Tamil Nadu, Kerala, Telangana, Rayalaseema and south interior Karnataka; *excess* over coastal Andhra Pradesh and Lakshadweep and *deficient* over coastal & north interior Karnataka. Northeast monsoon rains ceased in these regions on 8 January 2004, with a delay of about a week.

Rainfall activity was generally subdued over the western half of the country.

2. Seasonal rainfall (October-December)

Out of the 36 meteorological sub-divisions, rainfall was *excess* in 9, *normal* in 9, *deficient* in 6 and *scanty* in 12.

The seasonal rainfall was *excess* in Assam & Meghalaya, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, Chattisgarh, coastal Andhra Pradesh and Lakshadweep; *normal* in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland-Manipur-Mizoram-Tripura, Jammu & Kashmir, Telangana, Rayalaseema, Tamil Nadu, south interior Karnataka and Kerala; *deficient* in west Uttar Pradesh, Haryana, east Madhya Pradesh, Vidarbha and coastal & north interior Karnataka and was *scanty* in east Uttar Pradesh, Uttaranchal, Punjab, Himachal Pradesh, Rajasthan, west Madhya Pradesh, Gujarat State, Konkan & Goa, Madhya Maharashtra and Marathwada. Seasonal sub-division wise percentage rainfall departures are given in Fig. 2 and also in Table 1.

3. Monthly features

3.1. *October*

3.1.1. *Withdrawal of southwest monsoon*

Southwest monsoon withdrew from the northwestern parts of the country by 1 October (in the near normal date), from central India by 11 October (a few days ahead of the normal date), from entire northeast India and some parts of southern peninsula by 13 October (2 days ahead of the normal date). It withdrew from the entire country on 15 October, the normal date of withdrawal of southwest monsoon.

3.1.2. *Commencement of northeast monsoon rains*

Northeast monsoon rains commenced over Tamil Nadu, Kerala and adjoining states of Karnataka and Andhra Pradesh on 19 October, near the normal date.

3.1.3. *Storms/Depressions*

During the month, one Depression and one deep depression formed over the Bay of Bengal. Details are presented below :

3.1.3.1. *Depression over the Bay of Bengal (6 – 9 October 2003)*

A low pressure area lay over south Bay and the adjoining west-central Bay off north Tamil Nadu-south Andhra coasts on 4 & 5. It concentrated into a depression over west-central Bay and lay centred at 0300 UTC of 6 near Lat. 16.5° N/ Long. 84.0° E. Moving northwards, it lay near Lat. 17.5° N/Long. 84.0° E at 1200 UTC of 6 and crossed north Andhra coast near Kalingapatnam during the early morning of 7. It lay centred at 0300 UTC of 7 near Lat. 19.0° N/Long. 83.0° E, about 100 kms east of Jagdalpur and remained practically stationary over there until the evening of 7. Subsequently, it moved further northnorthwestwards and lay centred near Lat. 21.0° N/ Long. 82.5° E, about 100 kms eastsoutheast of Raipur at

† Definition of terms in *Italics* are given in Appendix.

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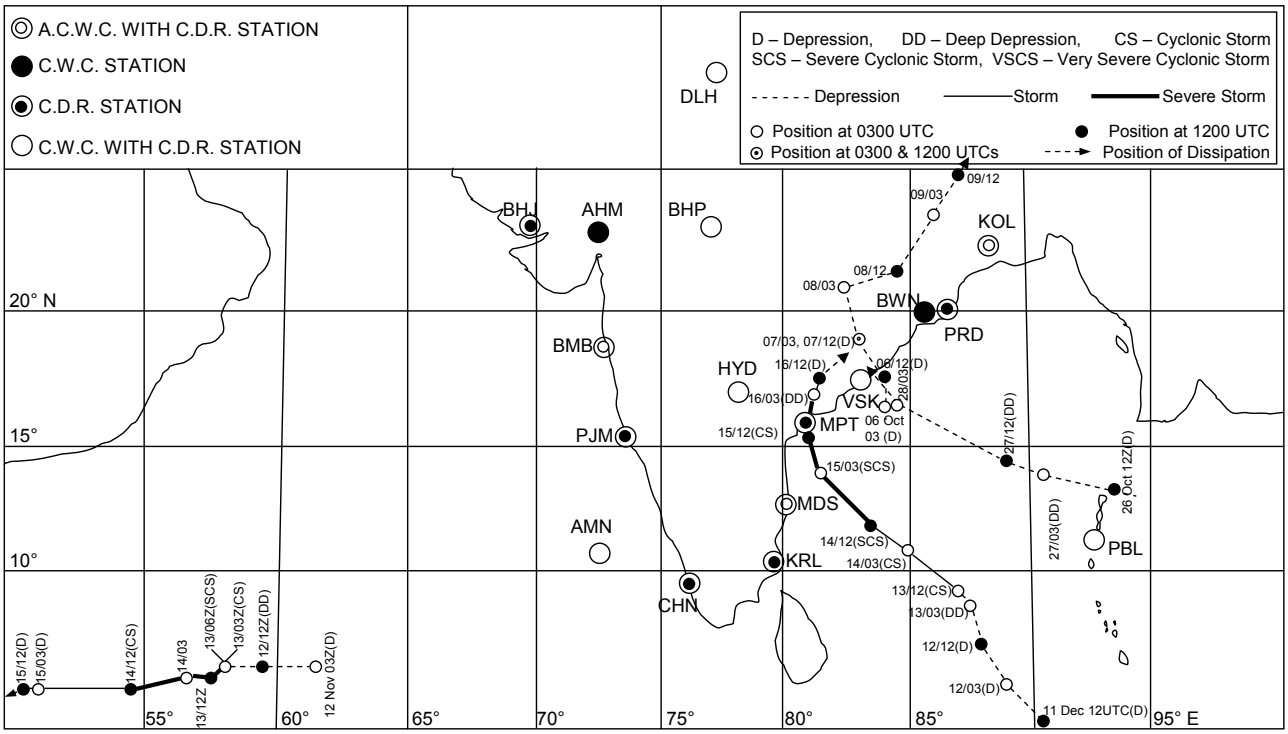


Fig. 1. Tracks of cyclonic storms/depressions during the period October to December 2003

0300 UTC of 8. Then moving in a northeasterly direction, it lay centred near Jharsuguda in the evening of 8. Later, moving in a northeasterly direction, it lay over Jharkhand, centred close to Dhanbad at 0300 UTC of 9 and over Bihar and neighbourhood and centred near Bhagalpur at 1200 UTC of 9. Subsequently, it weakened into a well-marked low pressure area over Sub-Himalayan West Bengal & Sikkim and neighbouring areas at 0300 UTC of 10 and lay as a low pressure area over the same area in the evening.

The maximum intensity of the system as reported by Kalpana I satellite was T 1.5 from 0800 UTC of 6 to 0300 UTC of 7.

Heavy to very heavy rain occurred over West Bengal, Orissa, Bihar, Jharkhand and Andhra Pradesh during 6 to 9 October. Chief amounts of rainfall in cms are :

6 Oct : Chandbali 27, Digha & Balasore 23 each, Kalingapatnam 12.

7 Oct : Canning Town 23, Sompeta 17, Kolkata 16, Visakhapatnam 15, Mohanpur 14, Salur, Midnapur & Parvathipuram 13 each.

8 Oct : Tenughat 22, Konal 16, Ramgarh 15, Messanjore 13, Gajoldoba & Jharsuguda 9 each.

9 Oct : Malda 15, Cooch Behar 13.

Thirteen people died due to the havoc caused by the depression. Number of villages were affected and 39,000 acres of paddy crops submerged in Andhra Pradesh. More than 40,000 people were waterlogged in Ghatala (West Bengal). Train traffic was affected due to heavy rain. Kolkata city and nearby villages were also badly affected due to heavy rain. On 9, a Tornado of light intensity in Murshidabad district injured 11 persons and damaged houses and agricultural products on 6 acres of land.

3.1.3.2. *Deep Depression over the Bay of Bengal (26 – 28 October 2003)*

Under the influence of an upper air cyclonic circulation which extended upto mid tropospheric levels over southeast Bay and adjoining Andaman Sea, a low pressure area formed over north Andaman Sea at 0300 UTC of 26. In the evening of the same day, it concentrated into a depression and lay centred within half a degree of Lat. 13.5° N/Long. 93.5° E. It further intensified into a deep depression at 0300 UTC of 27 and lay centred within

TABLE 1

Sub-division wise rainfall (mm) for each month and season as a whole (October-December 2003)

S. No.	Meteorological sub – divisions	October			November			December			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A. & N. Islands	345	313	10	185	268	-31	215	201	7	744	781	-5
2.	Arunachal Pradesh	202	165	23	23	41	-46	14	34	-60	238	240	-1
3.	Assam & Meghalaya	223	159	40	14	25	-43	21	10	104	258	194	33
4.	Naga., Mani, Mizo. and Tri.	145	154	-6	10	40	-76	50	9	446	205	203	1
5.	Sub-Himalayan West Bengal & Sikkim	278	156	78	17	19	-13	26	11	133	321	187	72
6.	Gangetic West Bengal	344	123	180	9	20	-55	19	5	245	373	149	150
7.	Orissa	339	122	177	12	30	-59	30	5	485	381	157	142
8.	Jharkhand	256	85	202	13	10	30	8	4	95	277	99	180
9.	Bihar	162	73	122	0	5	-100	7	3	112	169	82	107
10.	East Uttar Pradesh	8	50	-84	0	4	-100	15	6	170	23	60	-61
11.	West Uttar Pradesh	0	38	-100	1	4	-85	21	7	228	22	49	-55
12.	Uttaranchal	0	58	-100	3	8	-60	32	21	53	35	87	-60
13.	Haryana, Chandigarh & Delhi	0	18	-100	1	5	-89	15	7	104	16	30	-48
14.	Punjab	0	22	-100	5	5	-6	9	15	-39	14	41	-67
15.	Himachal Pradesh	**	44	-99	12	17	-31	23	40	-43	34	100	-66
16.	Jammu & Kashmir	9	31	-71	31	26	18	76	62	23	115	119	-3
17.	West Rajasthan	**	5	-96	**	3	-97	**	2	-89	1	9	-95
18.	East Rajasthan	**	15	-98	0	7	-100	1	3	-68	1	26	-95
19.	West Madhya Pradesh	2	32	-93	2	13	-83	2	6	-75	6	52	-88
20.	East Madhya Pradesh	20	39	-49	3	11	-73	5	9	-43	28	59	-53
21.	Gujarat region	3	24	-86	0	12	-100	0	2	-100	3	37	-91
22.	Saurashtra & Kutch	5	17	-73	0	13	-100	0	1	-100	5	31	-85
23.	Konkan & Goa	38	106	-64	**	27	-99	0	5	-100	38	137	-72
24.	Madhya Maharashtra	30	71	-58	1	28	-96	0	6	-99	31	105	-70
25.	Marathwada	11	66	-83	1	21	-93	1	7	-92	13	95	-86
26.	Vidarbha	30	53	-44	1	14	-90	2	8	-72	33	75	-56
27.	Chattisgarh	124	63	97	4	9	-58	26	4	502	153	76	102
28.	Coastal Andhra Pradesh	297	195	52	9	95	-90	90	22	315	396	311	27
29.	Telangana	109	83	30	**	21	-98	17	4	312	127	108	17
30.	Rayalaseema	183	122	50	5	68	-93	4	25	-85	192	215	-11
31.	Tamil Nadu	212	187	13	196	184	7	26	99	-74	435	469	-7
32.	Coastal Karnataka	187	185	1	15	68	-78	0	14	-100	202	267	-24
33.	North interior Karnataka	104	104	0	3	29	-91	1	6	-81	108	139	-23
34.	South interior Karnataka	204	141	45	11	40	-73	**	13	-99	215	203	6
35.	Kerala	389	294	32	86	167	-49	8	45	-82	483	506	-5
36.	Lakshadweep	192	153	25	206	117	76	7	59	-87	405	329	23

** Rainfall amount upto 0.5 mm.

half a degree of Lat. 14.0° N / Long. 90.5° E, about 900 kms southeast of Visakhapatnam. Moving in a westnorthwesterly direction, it lay over east-central Bay at 1200 UTC of 27 within half a degree of Lat. 14.5° N / Long. 89.0° E. It further moved in a northwesterly direction and lay centred at 1800 UTC of 27 close to Lat. 16.0° N / Long. 87.0° E, about 500 kms southeast of Visakhapatnam. Continuing its northwesterly movement, it lay centred at 0300 UTC of 28 within half a degree of Lat. 16.5° N / Long. 84.5° E. It crossed coastal Andhra Pradesh between Visakhapatnam and Kalingapatnam around 1000 UTC of 28 and rapidly weakened into a low pressure area and lay over northern parts of coastal Andhra Pradesh and adjoining Chattisgarh. It became less marked on 29.

The maximum intensity of the system as reported by Kalpana-I was T 1.5 from 1200 UTC of 26 to 0300 UTC of 28.

No damage was reported. Heavy rain occurred over coastal Andhra Pradesh. Chief amounts of rainfall in cms are :

27 Oct : Rajghat 4, Chandbali 3.

28 Oct : Diamond Harbour & Digha 5 each, Kolkata & Bardhaman 4 each.

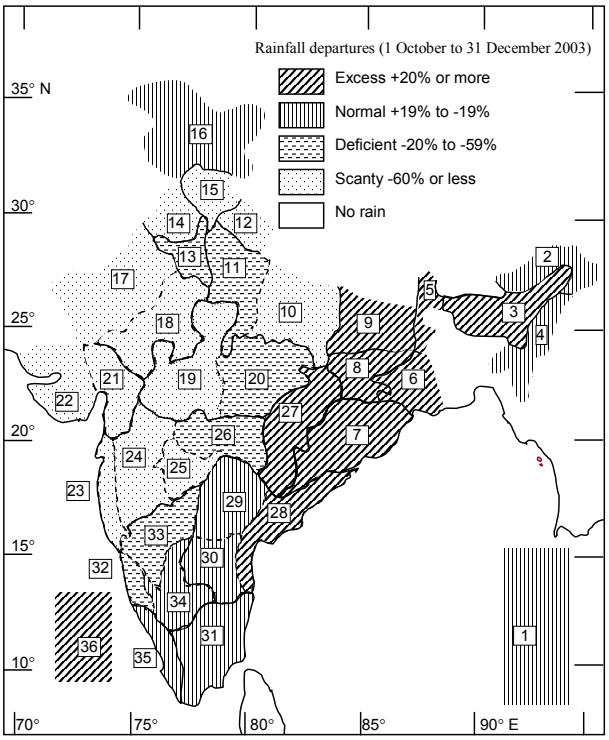
29 Oct : Dummagudem 12, Chodavaram, Prathipadu & Salur 3 each.

3.1.4. *Weather and associated synoptic features*

Table 2 gives details of synoptic features for the month of October 2003.

Southwest monsoon was *vigorous* on 3 to 4 days in Gangetic West Bengal, Orissa, coastal Andhra Pradesh and Rayalaseema and on 1 to 2 days in Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Jharkhand and Karnataka. It was *active* on 3 to 4 days in Assam & Meghalaya, Rayalaseema and south interior Karnataka and on 1 to 2 days in Arunachal Pradesh, Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Orissa, Bihar, coastal Andhra Pradesh, coastal & north interior Karnataka and Kerala.

Heavy to *Very Heavy* rainfall occurred on 4 to 5 days in Orissa and coastal Andhra Pradesh and on 1 to 3 days in Assam & Meghalaya, West Bengal & Sikkim, Jharkhand, Bihar, Chattisgarh, Tamil Nadu, coastal Karnataka and Kerala. *Heavy* rainfall also occurred on 17 days in Tamil Nadu; on 4 to 7 days in Gangetic West Bengal, Orissa, Bihar, coastal Andhra Pradesh, south



Excess – 9, Normal – 9, Deficient – 6, Scanty - 12

Fig. 2. Sub-divisionwise seasonal rainfall departure from normal (%) for Post monsoon season (October to December 2003). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	–5	**7**	142	**13**	–48	**19**	–88	**25**	–86	**31**	–7
2	–1	**8**	180	**14**	–67	**20**	–53	**26**	–56	**32**	–24
3	33	**9**	107	**15**	–66	**21**	–91	**27**	102	**33**	–23
4	1	**10**	–61	**16**	–3	**22**	–85	**28**	27	**34**	6
5	72	**11**	–55	**17**	–95	**23**	–72	**29**	17	**35**	–5
6	150	**12**	–60	**18**	–95	**24**	–70	**30**	–11	**36**	23

interior Karnataka and Kerala and on 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Chattisgarh, Rayalaseema and coastal & north interior Karnataka.

3.1.5. *Monthly rainfall*

Monthly rainfall was *excess* in 14, *normal* in 5, *deficient* in 3 and *scanty* in 10 meteorological sub-divisions. There was no rain over 4 meteorological sub-divisions. Rainfall was *excess* in Arunachal Pradesh, Assam & Meghalaya, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, Chattisgarh, Andhra Pradesh, south interior Karnataka, Kerala & Lakshadweep; *normal* in Andaman & Nicobar Islands, Nagaland-Manipur-Mizoram-Tripura and coastal & north interior Karnataka; *deficient* in east Madhya Pradesh, Madhya Maharashtra and Vidarbha and *scanty* in east Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Rajasthan, west Madhya

TABLE 2

Details of the weather systems during October 2003

S. No.	System	Duration	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Storms/depressions*					
1.	Depression	6-9	West-central Bay	Initially northerly and then northeasterly	Bihar and neighbourhood	It travelled in a near northerly direction inland, maintaining the intensity Details of the system are given in para 3.1.3.1.
2.	Deep Depression	26-28	Andaman Sea	Initially westnorth-westerly and then northwesterly	Northern parts of coastal Andhra Pradesh and adjoining Chattisgarh	Details of the system are given in para 3.1.3.2.
(**B**)	*Low pressure area*					
1.	Well-marked low pressure area	3 – 6	Lakshadweep area and neighbourhood	Quasi-stationary	Southeast Arabian Sea and adjoining Lakshadweep area	Less marked on 7
2.	Low pressure area	16 eve – 26	West-central and adjoining southwest Bay off south Andhra-north Tamil Nadu coasts	Northnorth-easterly	Northwest, west-central Bay and adjoining coastal areas of Orissa and West Bengal	The system was first observed as a cyclonic circulation over the same area on 16 morning. Associated cyclonic circulation extended upto mid tropospheric levels. A trough at 0.9 km a.s.l. extended from this system northwestwards to northern parts of Madhya Maharashtra on 20 & 21
3.	Low pressure area	21 – 22	East-central Arabian Sea off Karnataka-Maharashtra coasts	Stationary	*In situ*	Less marked on 23
(**C**)	*Western disturbances /eastward moving systems*					
1.	As an upper air cyclonic circulation	7 – 9	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away eastnortheastwards on 10
2.	Do	9 eve – 12	North Pakistan and neighbourhood	Do	Do	Moved away eastnortheastwards on 13
3.	Do	13 – 15	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away eastnortheastwards on 16
4.	Do	16 – 17	Do	Do	Do	Moved away eastnortheastwards on 18
5.	Do	18 eve – 23	Do	Do	Do	Moved away eastnortheastwards on 24
6.	Do	23 – 27	Do	Do	Eastern parts of Jammu & Kashmir and neighbourhood	Moved away eastnortheastwards on 28
7.	Do	29 Oct – 1 Nov	Do	Do	Jammu & Kashmir and adjoining Uttaranchal	Moved away eastnortheastwards on 2 November
(**D**)	*Other cyclonic circulations*					
1.	Mid tropospheric levels	11 – 16	West-central and adjoining southwest Bay off south Andhra –north Tamil Nadu coasts	Southwesterly	Southwest and adjoining west-central Bay off Sri Lanka-south Tamil Nadu coasts	Less marked on 17

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	Mid tropospheric levels	14 – 18	Andaman Sea	Quasi-stationary	Andaman Sea and adjoining southeast Bay	Merged with the low pressure area on 19
3.	Lower tropospheric levels	14	Lakshadweep area and adjoining southeast Arabian Sea	Stationary	*In situ*	Less marked on 15
4.	Mid tropospheric levels	18 – 19	North Andaman Sea	Do	Do	Less marked on 20
5.	Lower levels	26	South Tamil Nadu and adjoining areas	Do	Do	Less marked on 27
6.	Mid tropospheric levels	26 – 27	East-central Arabian Sea off Maharashtra-Karnataka coasts	-	-	It was seen as a trough of low at sea level over Maharashtra-Goa coasts to Lakshadweep area off Karnataka-Kerala coasts from 28 October to 11 November. A cyclonic circulation in the lower levels lay embedded over Lakshadweep area off Kerala coast in the above trough on 30 & 31 October
7.	Mid tropospheric levels	31 Oct – 4 Nov	Assam & Meghalaya and neighbourhood	Southeasterly	Nagaland-Manipur-Mizoram-Tripura and neighbourhood	Less marked on 5 November
(**E**)	*Troughs in westerly*					
1.	Lower levels	2 – 3	Long. 87° E, north of Lat. 20° N	Stationary	*In situ*	Less marked on 4
(**F**)	*Troughs in easterly*					
1.	Sea level	10 – 13	Maharashtra to Kerala coasts	Stationary	*In situ*	Less marked on 14
2.	Do	28 Oct – 19 Nov	South Andaman Sea and neighbourhood	Westerly	Southwest Bay off Sri Lanka-Tamil Nadu coasts	It lay as a well marked trough of low over southwest Bay and adjoining areas of Sri Lanka and south Tamil Nadu during 7 to 9 Nov; over southwest Bay and adjoining Sri Lanka on 10 and over Comorin-Maldives areas on 12. It lay over Comorin areas on 18 and less marked on 19
(**G**)	*Other troughs*					
1.	Lower levels	30 Oct – 2 Nov	South Maharashtra-Goa coasts to west Madhya Pradesh through Madhya Maharashtra	Do	Do	Less marked on 3 Nov

Pradesh, Gujarat State, Konkan & Goa and Marathwada. There was no rain over west Uttar Pradesh, Uttaranchal, Haryana and Punjab. The significant amounts of rainfall during the month are given in Table 5.

3.1.6. *Temperature*

Day temperatures were *appreciably* to *markedly above normal* on 25 days in some parts of Saurashtra & Kutch; on 8 to 14 days in some parts of Uttaranchal, Himachal Pradesh, east Rajasthan, Gujarat Region and of Konkan & Goa; on 4 to 7 days in some parts of Jammu & Kashmir, west Rajasthan, Madhya Maharashtra, Marathwada, Vidarbha, Chattisgarh, Rayalaseema and of coastal Karnataka and on 1 to 3 days in some parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, Uttar Pradesh, Madhya Pradesh,

coastal Andhra Pradesh, Telangana, Tamil Nadu, south interior Karnataka and of Kerala and were *above normal* on 15 to 17 days in some parts of Rajasthan and of Madhya Maharashtra; on 8 to 12 days in some parts of Assam & Meghalaya, east Uttar Pradesh, Uttaranchal, Himachal Pradesh, Jammu & Kashmir, west Madhya Pradesh, Gujarat Region and of Tamil Nadu; on 4 to 7 days in some parts of Nagaland-Manipur-Mizoram-Tripura, Gangetic West Bengal, Orissa, west Uttar Pradesh, east Madhya Pradesh, Konkan & Goa, Marathwada, Vidarbha, coastal Andhra Pradesh, Telangana, coastal Karnataka and of Kerala and on 1 to 3 days in some parts of Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, Haryana, Saurashtra & Kutch, Chattisgarh, Rayalaseema and of south interior Karnataka. They were generally *normal* or *below normal* over the rest of the country on the remaining days.

The month's highest maximum temperature in the plains of the country was 41° C recorded at Barmer (west Rajasthan) on 3 October and at Porbandar (Saurashtra) on 13 October 2003.

Night temperatures were *appreciably* to *markedly below normal* on 8 to 13 days in some parts of Uttaranchal, Punjab, Rajasthan, Gujarat Region and of Vidarbha; on 4 to 7 days in some parts of west Uttar Pradesh, Jammu & Kashmir, Madhya Maharashtra and of Marathwada and on 1 to 3 days in some parts of Orissa, Jharkhand, Bihar, east Uttar Pradesh, Haryana, west Madhya Pradesh, Saurashtra & Kutch, Konkan & Goa, Andhra Pradesh, Tamil Nadu and of interior Karnataka and were *below normal* on 8 to 13 days in some parts of east Uttar Pradesh, Haryana, Punjab, Jammu & Kashmir, Rajasthan and of Madhya Maharashtra; on 4 to 7 days in west Uttar Pradesh, Uttaranchal, west Madhya Pradesh and of Gujarat Region and on 1 to 3 days in some parts of Orissa, Jharkhand, Bihar, east Madhya Pradesh, Saurashtra & Kutch, Konkan & Goa, Marathwada, Vidarbha, Chattisgarh, Andhra Pradesh, Tamil Nadu, Karnataka and of Kerala. They were generally *normal* or *above normal* over the country on rest of the days.

The month's lowest minimum temperature in the plains of the country was 10° C, recorded at Amritsar (Punjab) on 30 October 2003.

3.1.7. *Disastrous weather events and associated damage*

According to press reports, in all 79 people (32 in Orissa, 14 each in Assam and Karnataka, 10 in West Bengal, 5 in Kerala and 4 in Maharashtra) lost their lives due to flood/lightning and heavy rains over the country. Crops in hundreds of acres were destroyed in Karnataka and Kerala due to very heavy rain over the region. Flood also took a toll of 482 cattle heads and damaged thousands of hectors of crops in Orissa during the month.

3.2. *November*

3.2.1. *Storms/Depressions*

During the month of November, one Severe Cyclonic Storm formed over the Arabian Sea. Details are presented below :

3.2.1.1. *Severe Cyclonic Storm over the Arabian Sea (12-15 November 2003)*

Under the influence of a trough of low over southeast Arabian Sea, a depression formed over southwest Arabian Sea at 0300 UTC of 12 and lay centred within half a degree of Lat. 6.5° N / Long. 61.5° E. It intensified into a Deep Depression and lay centred within half a degree of Lat. 6.5° N / Long. 59.5° E at 1200 UTC of 12. Continuing its westerly course, it intensified into a Cyclonic Storm and lay centred at 0300 UTC of 13 near Lat. 6.5° N / Long. 58.0° E. Subsequently, it intensified into a Severe Cyclonic Storm at 0600 UTC of 13 over the same area. Slowly moving westwards it lay centred at 1200 UTC of 13 near Lat. 6.0° N / Long. 57.5° E. Further moving westwards, it lay near Lat. 6.0° N / Long. 56.5° E at 0300 UTC of 14. Thereafter, it weakened into a Cyclonic Storm and lay centred at 1200 UTC of 14 near Lat. 5.5° N / Long. 54.5° E. Further moving westwards, it rapidly weakened into a depression which lay centred at 0300 UTC of 15 near Lat. 5.5° N / Long. 51.0° E and near Lat. 5.5° N / Long. 50.5° E at 1200 UTC of 15. The system weakened into a low pressure area on 16 morning and dissipated over the sea off Somalia coast thereafter.

The maximum intensity of the system reported by Kalpana I was T 3.5 from 0900 UTC of 13 to 0900 UTC of 14.

As the system formed and moved far away from the Indian coast, no adverse weather was experienced.

3.2.2. *Weather and associated synoptic features*

Details of synoptic features for the month of November 2003 are given in Table 3.

Northeast monsoon was *vigorous* as well as *active* on 1 day each in Tamil Nadu. *Very heavy* rainfall occurred on 1 day in Tamil Nadu. *Heavy* rainfall also occurred on 1 day each in Assam & Meghalaya, south interior Karnataka and Lakshadweep.

TABLE 3

Details of the weather systems during November 2003

S. No.	System	Duration	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Cyclonic storm/depression*					
1.	Severe Cyclonic Storm over the Arabian Sea	12 – 15	Southwest Arabian Sea	Westerly	Off Somalia coast	It was first observed as a trough of low on 11 over southeast Arabian sea. It became low pressure area on 12 morning. Other details of the system are given in para 3.2.1.1.
(**B**)	*Low pressure area*					
1.	Low pressure area	15 – 22	Southwest Bay and adjoining Sri Lanka – Tamil Nadu coasts	Easterly	Southeast Bay	Associated cyclonic circulation extended upto mid tropospheric levels. It was observed as a trough on sea level over the Andaman Sea on 14
(**C**)	*Western disturbances /Eastward moving systems*					
1.	Upper air cyclonic circulation	1 - 3	North Pakistan and adjoining areas of Afghanistan	Northeasterly	Northern parts of Jammu & Kashmir	Moved away on 4
2.	Low pressure area	4 – 6	Central Pakistan and adjoining west Rajasthan	Do	North Rajasthan and neighbourhood	It was seen as a low pressure area on 5 and moved away on 7
3.	Upper air cyclonic circulation	6 – 7	North Pakistan and adjoining Punjab and neighbourhood	Do	Jammu & Kashmir and neighbourhood	Moved away on 12
4.	Do	11 eve – 13	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 14
5.	Do	14 – 18	Jammu & Kashmir and neighbourhood	Do	Do	Moved away on 19
6.	Induced cyclonic circulation	14 – 20	Central Pakistan and adjoining west Rajasthan	Do	Uttaranchal and neighbourhood	Moved away on 21
7.	Upper air cyclonic circulation	20 – 21	North Pakistan and Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away on 22
8.	Do	22 – 26	Do	Do	Eastern parts of Jammu & Kashmir	Moved away on 27
9.	Do	27 eve – 29	Do	Do	Jammu & Kashmir and adjoining Punjab	Moved away on 30
10.	Do	30 Nov – 2 Dec	Do	Do	Northern parts of Jammu & Kashmir	Moved away on 3 December
(**D**)	*Cyclonic circulations*					
1.	Mid tropospheric levels	9 – 10	Nagaland-Manipur-Mizoram-Tripura and adjoining Bangla Desh	Stationary	*In situ*	Less marked on 11
(**E**)	*Troughs in easterly*					
1.	Sea level	3 – 5	Southeast Bay and adjoining south Andaman Sea	Westerly	Southwest and adjoining southeast Bay	Less marked on 6

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	Lower tropospheric levels	23 Nov – 9 Dec	Comorin-Maldives areas	Westerly	Southwest Arabian Sea	Moved away westwards on 10 December
3.	Sea level	23 Nov – 1 Dec	Southwest Bay	Do	Lakshadweep area	Merged with other trough over southeast Arabian on 2 December
4.	Do	24 – 28	Andaman Sea and adjoining southeast Bay	Do	Southeast Bay	Merged with the system over southwest Bay and adjoining Sri Lanka on 29
5.	Do	30 Nov – 11 Dec	Southwest Bay	Do	Southwest Arabian Sea	Less marked on 12
(**F**)	*Troughs in westerly*					
1.	Lower levels	7	Long. 89° E, north of Lat. 20° N	Stationary	*In situ*	Less marked on 8

3.2.3. *Monthly rainfall*

Monthly rainfall was *excess* in 2, *normal* in 4, *deficient* in 8 and *scanty* in 17 meteorological sub-divisions. There was no rain in the remaining 5 meteorological sub-divisions. It was *excess* in Jharkhand and Lakshadweep; *normal* in Sub-Himalayan West Bengal & Sikkim, Punjab, Jammu & Kashmir and Tamil Nadu; *deficient* in Andaman & Nicobar Islands, Arunachal Pradesh, Assam & Meghalaya, Gangetic West Bengal, Orissa, Himachal Pradesh, Chattisgarh and Kerala; *scanty* in Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Uttaranchal, Haryana, west Rajasthan, Madhya Pradesh, Maharashtra & Goa States, Andhra Pradesh and Karnataka. There was no rain in Bihar, east Uttar Pradesh, east Rajasthan and Gujarat State. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.2.4. *Temperature*

Cold wave conditions prevailed on 7 days in some parts of Punjab and on 1 day each in some parts of Haryana, Jammu & Kashmir and of Rajasthan. Night temperatures were *appreciably* to *markedly below normal* on 4 to 6 days in some parts of Orissa, Jharkhand, Haryana and of Punjab and on 1 to 3 days in some parts of Nagaland-Manipur-Mizoram-Tripura, Bihar, east Uttar Pradesh, Jammu & Kashmir, Rajasthan, Saurashtra & Kutch, Andhra Pradesh and Tamil Nadu and were *below normal* on 13 to 14 days in some parts of Orissa & Jharkhand; on 8 to 9 days in some parts of Uttaranchal, Punjab, Jammu & Kashmir, Rajasthan and of south interior Karnataka; on 4 to 7 days in some parts of Bihar, Haryana, Saurashtra & Kutch, coastal Andhra Pradesh, Telangana, Tamil Nadu and of north interior Karnataka. They were generally *normal* or *above normal* over the rest of the country on the remaining days.

Month's lowest minimum temperature in the plains of the country was 1° C recorded at Amritsar (Punjab) on 26 November 2003.

3.2.5. *Disastrous weather events and associated damage*

According to press reports, lightning took a toll of 7 human lives (3 in Vidarbha and 2 each in West Bengal and Kerala).

3.3. *December*

3.3.1. *Storms/Depressions*

During the month, only one Severe Cyclonic Storm formed over the Bay of Bengal. Details are given below :

3.3.1.1. *Severe Cyclonic Storm over the Bay of Bengal (11-16 December 2003)*

A trough in easterlies over Andaman Sea and adjoining southeast Bay organised into a low pressure area over southeast Bay on 11. It subsequently concentrated into a Depression and lay centred at 1200 UTC of 11 near Lat. 4.5° N/Long. 90.5° E, at 0300 of 12 near Lat. 6.0° N / Long. 89.0° E and at 1200 UTC of 12 near Lat. 7.5° N / Long. 88.0° E. Moving further northwestwards, it intensified into a Deep Depression and lay centred at 0300 UTC of 13 near Lat. 9.0° N / Long. 87.5° E. Slowly moving northwestwards, it further intensified into a Cyclonic Storm which lay centred at 1200 UTC of 13, near Lat. 9.5° N / Long. 87.0° E. Thereafter, it continued

TABLE 4

Details of the weather systems during December 2003

S. No.	System	Duration	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Cyclonic storms/depressions*					
1.	Severe Cyclonic Storm the Bay of Bengal	11-16	Southeast Bay	Initially northwesterly, then northerly and finally northeasterly	Coastal Andhra Pradesh	Details of the system are given in para 3.3.1.1.
(**B**)	*Western disturbances /eastward moving cyclonic circulations*					
1.	Upper air cyclonic circulation	3 – 6	North Pakistan and adjoining Jammu & Kashmir and Punjab	Northeasterly	Eastern parts of Jammu & Kashmir	Moved away on 7
2.	Do	6 eve – 8	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away on 9
3.	Do	9 eve – 10	North Pakistan	Do	Do	Moved away on 11
4.	Do	11 eve – 14	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 15
5.	Do	16	Jammu & Kashmir and adjoining Pakistan	Do	Jammu & Kashmir and adjoining Pakistan	Moved away on 17
6.	Do	17 – 20	North Pakistan and adjoining Jammu & Kashmir and Punjab	Do	Uttaranchal and neighbourhood	Less marked on 21
7.	Do	18 eve – 25	North Pakistan and adjoining Jammu & Kashmir	Do	Uttaranchal and neighbourhood	Moved away on 26
8.	Do	26 – 27	North Pakistan and adjoining Jammu & Kashmir, Punjab and northwest Rajasthan	Do	Jammu & Kashmir	Moved away 28
9.	Do	28 – 31	Jammu and adjoining Pakistan	Do	Eastern parts of Jammu & Kashmir and neighbourhood	Moved away on 1 Jan 2004
10.	Do	31 Dec-2 Jan	North Pakistan and neighbourhood	Do	Jammu & Kashmir and neighbourhood	Moved away on 3 Jan 2004
(**C**)	*Western disturbance as induced systems*					
1.	Induced low pressure area	8 – 9	Central Pakistan and adjoining Rajasthan	Do	Northwest Rajasthan and neighbourhood	Less marked on 10. Associated cyclonic circulation extended upto mid tropospheric levels. It lay over west Uttar Pradesh and neighbourhood from 10 and became less marked on 12
2.	Induced cyclonic circulation	12 – 17	Central Pakistan and adjoining Rajasthan	Do	Haryana and adjoining west Uttar Pradesh on 7	Moved away on 18

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Induced cyclonic circulation	27	East Rajasthan and adjoining west Madhya Pradesh	Northeasterly		It was seen as a trough / wind discontinuity in the lower tropospheric levels on 28 and lay between 0.9 and 2.1 kms a.s.l. from Sub-Himalayan West Bengal & Sikkim to Orissa on 29 & 30
4.	Do	30 – 31	Uttaranchal and neighbourhood	Do		Moved away on 1 Jan 2004
5.	Do	31 Dec – 1 Jan ′04	South Rajasthan and neighbourhood	Do	North Rajasthan and neighbourhood	Less marked on 2 Jan 2004
(**D**)	*Other cyclonic circulations*					
1.	Mid tropospheric levels	4 – 12	Assam & Meghalaya	Westerly	Gangetic West Bengal and neighbourhood	Less marked on 13
2.	Lower tropospheric levels	16 – 17	South Andaman Sea and adjoining Tennasserim coast	Stationary	*In situ*	Less marked on 18
3.	Lower levels	26	Southern parts of Tamil Nadu and neighbourhood			Less marked on 27. A trough from the system extended northwards to Madhya Maharashtra, through interior Karnataka on 26 and from south Tamil Nadu to the centre of the system over east Rajasthan through interior parts of Karnataka, Maharashtra and west Madhya Pradesh on 27
(**E**)	*Troughs in easterly*					
1.	Sea level	1	Andaman Sea	Westerly	Southwest Bay	Less marked on 2
2.	Do	7	Lakshadweep area and adjoining southeast Arabian Sea	Do	Southwest Arabian Sea	Less marked on 11
3.	Do	8–10	Andaman Sea	Do	Andaman Sea and adjoining southeast Bay	Under the influence of this system, a low pressure area formed over southeast Bay which became the severe cyclonic storm thereafter.
4.	Do	19 Dec – 8 Jan ′04	South Andaman Sea	Do	Southwest Bay to northeast Bay across west-central Bay	Moved away westwards on 8
5.	Lower levels	25–26	Southeast Bay and adjoining south Andaman Sea	Do	Southeast Bay	Less marked on 27

to move in a northwesterly direction, lay centred at 0300 UTC of 14 near Lat. 11.0° N / Long. 85.0° E; it further intensified into a Severe Cyclonic Storm which lay centred at 1200 UTC of 14 near Lat. 12.0° N / Long. 83.5° E; at 0300 UTC of 15 near Lat. 14.0° N / Long. 81.5° E and at 1200 UTC of 15 near Lat. 15.5° N / Long. 81.0° E, about 80 kms south of Machilipatnam. Subsequently moving northwards, it crossed south Andhra coast close to Machilipatnam around the midnight and weakened into a Cyclonic Storm, which lay centred at 2100 UTC of 15 close to Gannavaram. It moved northeastwards and further weakened into a Deep Depression, and lay centred at 0300 UTC of 16 close to Nidadavolu. Thereafter, it rapidly weakened into a low pressure area over north coastal Andhra Pradesh in the evening of 16 and became less marked on 17.

TABLE 5

Principal amounts of rainfall (3 cm and above)

Date	October	November	December
(1)	(2)	(3)	(4)
1.	Jabalpur 7, Chouldhowaghat, Jagdalpur, Kunda Bridge, Chickmaglur & Agathi 5 each, Numaligarh, Kolkata, Yeotmal & Valparai 4 each, Nancowry, Kondul, Balukpong, Bihubar & Nasik 3 each	Lakhipur 10, Kheronighat, Multai & Balasore 6 each, Jashpurnagar & Panambur 5 each, Sundargarh, Nagapattinam, Cochi & Nagapattinam 4 each, Digha, Kolkata, Cuttack, Ranchi, Parbhani & Pamban 3 each	Nil
2.	Sathyamangalam 23, Parambikulam 10, Siddapura 9, Car Nicobar, Badami, K. R. Pet & Quilandy 7 each, Silchar, Coimbatore, Thiruvananthapuram & Kozhikode 4 each, Jalpaiguri 3	Haripad & Phulbani 6 each, Ranibandh 5, Jamshedpur, Kondul & Jamshedpur 4 each, Cuttack, Coonoor & Kottayam 3 each	Nil
3.	Nedumangad 12, Champua & Mudukulathur 11 each, Murti 10, Sriniketan, Pandavapura, Coonoor & Thiruvananthapuram 9 each, Taibpur & Punalur 7 each, Kottayam & Alapuzha 6 each, Tadong & Panambur 5 each, Sangli, Nandigama, Salem, Madikeri & Agathi 4 each, Nancowry, Kondul, Guwahati, Gangtok, Kolhapur, Pondicherry, Mangalore, Bagalkote & Gadag 3 each	Kondul 7, Bargarh, Jagatsinghpur & Nilambur 6 each, Haripad 4, Contai, Kozhikode, Mavelikara & Thiruvananthapuram 3 each	Nil
4.	Bhatkal 21, Gajoldoba 14, Talaguppa 12, Haunsabhavi 10, Sirsi & Ottapalam 9 each, Gopalpur 8, Gingee & Penukonda 7 each, Port Blair & Honavar 4 each, Dibrugarh, Kakinada, Pamban, Bijapur, Agumbe & Karipur 3 each	Panambur 5, Bantwal 4, Mangalore & Cuttack 3 each	Nil
5.	Pariakhemundi 14, Port Blair & Chintapalli 10 each, Simulia, Peermadu & Linganarnakki 9 each, Araria, Barur, Sirsi & Chickmagalur 7 each, Digha, Chandbali & Vellore 6 each, Paradip 5, Tadong 4, Dibrugarh, Kodaikanal & Thiruvananthapuram 3 each	Vedaranyam 4, Pondicherry 3	Nil
6.	Mahendragarh 19, Sompeta 18, Gopalpur 16, Berhampur 15, Peermadu 14, Thodupuzha, Puri & Kalingapatnam 12 each, Chandbali 11, Paradip 10, Nagrakata & Tiptur 9 each, Jayakindan, Thiruvananthapuram & Bhubaneswar 8 each, Gadag, Cochi & Kottayam 6 each, Nancowry & Bangalore 5 each, Beki Mathanguri, Canning Town & Waltair 4 each, Maya Bandar & Kolkata 3 each	Pamban 7, Karaikal 5, Coonoor & Karipur 3 each	Nil
7.	Mohana 31, Chandbali 27, Pottangi 24, Balasore & Digha 23 each, Aluva & Sompeta 17 each, Cial Cochi 16, Tekkali 15, Waltair 12, Cuttack 10, Sagar & Midnapore 9 each, Gudiyatham & Kolkata 7 each, Pune & Amini Divi 5 each, Valparai 4	Pamban 8, Manamelkudy 7, Cuddalore & Palayamkottai 5 each, Tuticorin & Karaikal 4 each, Gajoldoba, Tezpur & Adirampattinam 3 each	Nil
8.	Canning Town 23, Manmathanagar 19, Kolkata 16, Digha, Kendrapara & Jagdalpur 14 each, Midnapore & Paddampur 13 each, Chengannur 9, Cochi 7, Bhubaneswar 5, Mahabaleshwar & Agathi 4 each, Ranchi & Kolhapur 3 each	Pamban & Coonoor 5 each, Uthagamandalam & Tuticorin 4 each, Hasimara, Chennai & Karaikal 3 each	Nil
9.	Tenughat 22, Tantloi & Messanjore 13 each, Sobong 12, Dinhata 11, Ranchi 10, Gajoldoba, Jharsuguda 9, Reamal & Sikandarpur 8 each, Canning Town & Bhira 7 each, Goalpara 6, Dhubri & Baghdogra 5 each, Jalpaiguri & Madikeri 4 each, Agartala 3	Nagapattinam 17, Karaikal 8, Pondicherry, Agathi 6, Amini Divi 5, Tuticorin 4, Yedwad & Bangalore 3 each	Nil
10.	Chanchal 24, Dengraghat 22, Shillong 19, Goalpara & Colgoan 17 each, Malda 15, Tezpur & Jhawa 14 each, Cooch Behar 13, Jalpaiguri & Bhagalpur 11 each, Berhampore 9, Tadong, Berhampur, Paradip & Agathi 4 each, Sangli 3	Tarikere 8, Minicoy 7, Cuddalore & Pondicherry 5 each, Thanjavur & Nagapattinam 3 each	Kondul 10

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
11.	Karimganj 7, Kondul 5, Yelhanka & Car Nicobar 4 each, Dibrugarh & Vellore 3 each	Nil	Kondul 7, Nancowry 5
12.	Hasimara 14, Bangalore 11, Kanakapura 8, Amini Divi 4, Belgaum, Jalpaiguri & Balehonnur 3 each	Car Nicobar 3	Hut Bay 17, Kondul 13, Car Nicobar 12, Nancowry 11
13.	Tiruppur 10, Alapuzha & Cochi 8 each, Cochi 7, Coimbatore 5, Kodaikanal, Mulki, Trichy Town & Kodaikanal 4 each, Salem 3	Kondul 3	Hut Bay 4, Port Blair 3
14.	Kottayam 11, Palacode & Kumarakom 10 each, Sulurpet 8, Alapuzha 7, Chennai & Coimbatore 5 each, Kondul 4, Baghdogra, Madurai & Salem 3 each	Car Nicobar 6, Kaveli & Pondicherry 3 each	Doda 8, Kupwara 6, Anantnag, Banihal & Srinagar 3 each
15.	Silchar 8, Amraghat 7, Maya Bandar & Valparai 3 each	Nagapattinam & Tondi 6 each, Karaikal 5, Nagamangala, Adirampattinam & Palayamkottai Thanjavur 4 each, Pamban 3	Srinagar 5, Baramulla & Kupwara 4 each, Ajnala & Banihal 3 each
16.	Shenkottah 11, Madurai 7, Alapuzha 5, Punalur 4, Agartala 3	Hut Bay 7, Car Nicobar & Pamban 3 each	Repalle 19, Bhimadole 17, Shimla, Anantnag, Doda & Banihal 5 each, Jagdalpur & Batote 4 each, New Delhi, Bhuntar, Gurudaspur, Hindon & Tehri 3 each
17.	Kunda Bridge 16, Magra & Tikaballi 4 each, Car Nicobar, Kondul, Maya Bandar & Port Blair 3 each	Quazi Gund, Batote & Dudhani 3 each	Chintapalli & Solur 10 each, Parvathipuram 9, Gopalpur 6, Puri, Visakhapatnam, Kalingapatnam, Paradip & Puri 4 each, Durgachak & Jagdalpur 3 each
18.	Madurai 12, Chettikulam 11, Chettampatti 9, Puri 8, Dibrugarh & Arupukottai 5 each, Maya Bandar, Surapur & Karipur 4 each	Agathi 10, Dudhani 6, Nancowry, Quazi Gund, Batote, Kondul & Solangnala 4 each	Nil
19.	Mahendragarh 16, Majbat & Srimushnam 10 each, Aska 9, Nagapattinam, Sabroom & Erode 8 each, Tiruchirapalli & Pamban 7 each, Gopalpur 6, Pondicherry 5, Balasore, Kalingapatnam, Ongole & Nedumabaserry 3 each	Nil	Amraghat 14, Dholai 9, Kailashshahar 8, Agartala & Bashirhat 3 each
20.	Tambaram 11, Nedumbaserry 8, Erode 7, Nellore, Arogyavaram & Chennai 5 each, Car Nicobar 4, Matijuri, Hassan & Mandya 4 each, Kondul, Ranchi, Tiruchirapalli, Mangalore & Belgaum 3 each	Nil	Cochi 10, Imphal 6, Amraghat 5, Kailashshahar 4, Lakhimpur 3
21.	Nellore 13, Kandukur 10, Car Nicobar 9, Nancowry & Cuddapah 8 each, Kaveli, Kurnool & Hyderabad 6 each, Gaganbavada 5, Aska, Belgaum, Mandya & Alapuzha 4 each, Gangtok, Shahuwadi, Ongole, Karwar, Bellary & Chitradurga 3 each	Pamban 5, Kondul 3	Lakhimpur 6, Hut Bay 5, Nancowry & Dholai 4 each
22.	Palamner & Poondi 12 each, Porumamilla 11, Tambaram, Visakhapatnam & Waltair 10 each, Hindupur 9, Kaveli 8, Kakinada 7, Champua, Hyderabad & Chennai 6 each, Panambur 5, Pondicherry, Chitradurga & Cannur 4 each, Jamshedpur, Gopalpur, Jamshedpur, Anantpur, Mangalore, Bellary & Hassan 3 each	Nagapattinam & Pondicherry 5 each, Cuddalore, Vedaranyam & Karaikal 4 each, Minicoy 3	Nil
23.	Shimoga 13, Kakinada 12, Visakhapatnam 11, Poondi 10, Tuni 9, Bellary 8, Anantpur 7, Kollur, Yegati, Anantpur & Cochi 6 each, Ranchi 5, Chandrapur 4, Bhubaneswar, Udgir, Keonjhargarh Bhubaneswar, Raipur, Chitradurga & Shimoga 3 each	Nil	Nil

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
24.	Tuni 17, Kalingapatnam 14, Tekkali & Thiruvananthapuram 13 each, Sakti, Visakhapatnam & Parangipettai 10 each, Korba & Narsapur 8 each, Cuttack, Gopalpur, Cuddalore & Kakinada 7 each, Ranchi 5, Pendra, Raipur & Chennai 4 each, Daltonganj, Digha & Bangalore 3 each	Nil	Chennai 4
25.	Sompeta 15, Gaya & Ichhapuram 12 each, Keeranur & Tuni 8 each, Purnea, Puri, Gopalpur & Kalingapatnam 7 each, Contai, Sagar, Bhubaneswar, Kottayam & Punalur 5 each, Jalpaiguri & Daltonganj 4 each, Diamond Harbour, Patna, Asansol & Ambikapur 3 each	Hut Bay 3	Gudur 9, Kaveli 6, Nellore 5
26.	Balasore 14, K. B. Dam 12, Phusro 9, Viridhunagar 8, Jhalda 6, Hut Bay & Chandbali 5 each, Gangtok, Paradip, Hut Bay & Tadong 4 each, Jalpaiguri & Pamban 3 each	Hut Bay & Kondul 3 each	Ongole 4, Kaveli 3
27.	K. B. Dam 6, Berhampore 5, Maya Bandar, Bankura & Rajghat 4 each	Nil	Bapatla 5, Jhansi, Machilipatnam, Nagapattinam & Karaikal 3 each
28.	Burdhwan & Diamond Harbour 5 each, Digha 5, Kolkata 4, Berhampore, Krishnanagar, Baripada & Chandbali 3 each	Pondicherry 4, Adirampattinam & Parangipettai 3 each	Shhaswan 11, Saraipalli 6, Alapuzha 5, Hardoi 4
29.	Dummagudem 12, Kodaikanal 3	Pondicherry, Nagapattinam & Trichy Town 4 each, Kondul, Adirampattinam & Thanjavur 3 each	Gangtok 3
30.	Hazaribagh 4	Pondicherry 17, Cuddalore & Minicoy 11 each, Karaikal 9, Nagapattinam 8, Thanjavur 7, Tiruchirapalli 6, Tondi & Kodaikanal 3 each	Nil
31.	Ranibandh 12, Kalaikunda, Nasik, Konni & Piravom 6 each, Nancowry, Lakhimpur & Aryankavu 5 each, Cochi & Manmathanagar 4 each, Kondul & Sinnar 3 each	-	Nil

Maximum intensity of the system as given by Kalpana I was T 3.5 between 1200 UTC of 14 and 1500 UTC of 15.

According to official reports, 8 people died due to heavy rainfall associated with the system. About two thousand buildings were destroyed completely and more than seven thousand were partially damaged. Telecom and electric lines were disrupted. About 2 lakh hectares of agricultural land was affected by the system. Total cost of all damages was estimated to be about Rs.24, 000 lakh. Ship M. V. Nandak was got damaged and was at the verge of sinking near Machilipatnam. All the crew members were rescued by coast guards. Chief amounts of rainfall in cms are –

16 Dec : Repalle 19, Bheemadole & Koida 17 each, Nuzivid & Tenali 16 each, Machilipatnam & Kakinada 15 each, Gannavaram & Prakasam 13 each, Guntur 11, Tuni 10, Narasipatnam & Bapatla 8 each, Prathipadu, Dowleswaram, Peddapuram & Atchanta 7 each.

17 Dec : Salur & Chintapalli 10 each, Parvathipuram 9, Sriharikota 7, Paderu & Narasipatnam 5 each, Visakhapatnam & Gajapathinagaram 4 each.

3.3.2. *Weather and associated synoptic features*

Table 4 gives the details of synoptic features for the month of December 2003.

Northeast monsoon has been vigorous on 1 day in coastal Andhra Pradesh. *Heavy* to *Very heavy* rain occurred on 1 day each in Andaman & Nicobar Islands, Assam & Meghalaya and coastal Andhra Pradesh. *Heavy* rain also occurred on 1 to 2 days in Andaman & Nicobar Islands, Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Jammu & Kashmir, coastal Andhra Pradesh and Kerala.

3.3.3. *Monthly rainfall*

Monthly rainfall was *excess* in 15, *normal* in 1, *deficient* in 3 and *scanty* in 13 meteorological sub-divisions. There was no rain in the remaining 4 meteorological sub-divisions. It was *excess* in Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, Uttar Pradesh, Uttaranchal, Haryana, Jammu & Kashmir, Chattisgarh, coastal Andhra Pradesh and Telangana; *normal* in Andaman & Nicobar Islands; *deficient* in Punjab, Himachal Pradesh and east Madhya Pradesh; *scanty* in Arunachal Pradesh, Rajasthan, west Madhya Pradesh, Madhya Maharashtra, Marathwada, Vidarbha, Rayalaseema, Tamil Nadu, interior Karnataka, Kerala and Lakshadweep and there was no rain in Gujarat State, Konkan & Goa and coastal Karnataka. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.3.4. *Temperature*

Cold wave conditions prevailed on 4 to 5 days in some parts of Punjab and of east Rajasthan and on 1 to 2 days in some parts of West Bengal & Sikkim, Bihar, Uttar Pradesh, Haryana, west Rajasthan, Madhya Pradesh, Gujarat State, Konkan & Goa and of Madhya Maharashtra. *Cold day* conditions also prevailed on 9 days in some parts of Haryana; on 4 to 6 days in some parts of Uttar Pradesh and of Punjab and on 1 to 2 days in some parts of Uttaranchal, west Rajasthan and of Madhya Pradesh. Night temperatures were *appreciably* to *markedly below normal* on 4 to 8 days in some parts of Orissa, Jharkhand, Bihar, Punjab, Rajasthan, west Madhya Pradesh, Gujarat State, Konkan & Goa, Vidarbha, coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, Karnataka and of Kerala and on 1 to 3 days in some parts of Sub-Himalayan West Bengal & Sikkim, Uttar Pradesh, Uttaranchal, Himachal Pradesh, Jammu & Kashmir, east Madhya Pradesh, Madhya Maharashtra, Marathwada and of Telangana and were below normal on 8 to 13 days in some parts of Orissa, Jharkhand, east Madhya Pradesh, Madhya Maharashtra, coastal Andhra Pradesh, Telangana, Tamil Nadu and coastal & south interior Karnataka; on 4 to 7 days in some parts of Bihar, east Uttar Pradesh, Uttaranchal, Jammu & Kashmir, Saurashtra & Kutch, Konkan & Goa, Vidarbha, Rayalaseema, north interior Karnataka and of Kerala and on 1 to 3 days in some parts of Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Haryana, Punjab, Rajasthan, Gujarat Region, Marathwada and of Chattisgarh. They were above normal on most of the days during 2nd and 3rd week of the month over north, central and western parts of the country.

Month's and season's lowest minimum temperatures in the plains of the country was –1.7° C recorded at Amritsar (Punjab) on 29 December 2003.

3.3.5. *Disastrous weather events*

According to press reports, more than 110 people lost their lives altogether in the northern parts of the country due to cold wave. Also road and rail traffic were disrupted in Jammu & Kashmir due to snow fall.

Appendix

Definitions of the terms given in '*Italics*'

Rainfall

Excess	- percentage departure from normal is + 20% or more.
Normal	- percentage departure from normal is from –19 % to + 19 %.
Deficient	- percentage departure from normal is from –20 % to –59 %.
Scanty	- percentage departure from normal is from –60 % to –99 %.
Heavy rain	- rainfall amount is from 6.5 cm to 12.4 cm.
Very heavy rainfall	- rainfall amount is 12.5 cm or more.
At most places	- 75 % or more stations of a meteorological sub-division reporting at least 2.5 mms rainfall.
At many places	- 51% to 74 % stations of a meteorological sub-division reporting at least 2.5 mms rainfall.
At a few places	- 26 % to 50% stations of a meteorological sub-division reporting at least 2.5 mms rainfall.
At isolated places	- 25% or less stations of a meteorological sub-division reporting at least 2.5 mms rainfall.

Monsoon activity

(a) Southwest monsoon

Vigorous	- rainfall exceeding 4 times the normal with, minimum of two stations reporting rainfall more than or equal to 8 cm along the west coast and 5 cm elsewhere. Rainfall in that sub-division should be fairly widespread or widespread.
Active	- rainfall more than 1½ to 4 times the normal, with minimum of two stations reporting rainfall more than or equal to 5 cm along the west coast and 3 cm elsewhere. Rainfall in that sub-division should be fairly widespread or widespread.

(b) Northeast monsoon

Vigorous - rainfall exceeding 4 times the normal with minimum of two stations reporting rainfall more than or equal to 5 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 3 cm elsewhere in the northeast monsoon region. Rainfall in that sub-division should be fairly widespread or widespread.

Active - rainfall more than 1½ to 4 times the normal, with minimum of two stations reporting rainfall more than or equal to 3 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 2 cm elsewhere in the northeast monsoon region. Rainfall in that sub-division should be fairly widespread or widespread.

Temperatures

(a) Maximum / Day temperature

Markedly above normal - departure from normal is +5° C to +6° C (where the normal maximum temperature is 40° C or less).

Appreciably above normal - departure from normal is +3° C to +4° C (where the normal maximum temperature is 40° C or less).

Above normal - departure from normal is +2° C.

Normal - departure from normal +1° C to –1° C

(b) Minimum / Night temperature

Cold wave conditions - When the wind chill effective minimum temperature (WCTn) is 10° C or less: For stations whose normal minimum temperature is ≥ 10° C, when the departure from normal is – 5° to – 6° C, and for stations whose normal minimum temperature is less than 10° C when the departure from normal is –4° to –5° C. Also when WCTn is ≤ 0° C, cold wave is declared irrespective of the departure for those stations whose normal minimum temperature is greater than 0° C.

Markedly below normal - departure from normal is –5° C to –6° C (where the normal minimum temperature is 10° C or more).

Appreciably below normal - departure from normal is between –3° C to –4° C (where the normal minimum temperature is 10° C or more).

Below normal - departure from normal is –2° C

Normal - departure from normal is +1° C to –1° C.