MAUSAM, **54**, 4 (October 2003), 963-978

Weather in India

POST-MONSOON SEASON (October-December 2002)*

1. Introduction

During the post-monsoon season of 2002, one depression (22-23 October 2002), one severe cyclonic storm (10-12 November 2002) and two cyclonic storms (23-28 November and 21-25 December 2002) formed over the Bay of Bengal. No cyclonic storm formed over the Arabian Sea. Tracks of the storms and the depression are shown in Fig. 1.

Southwest monsoon withdrew from the entire country on 25 October and simultaneously northeast monsoon rains commenced over Tamil Nadu, Kerala and adjoining areas of Karnataka and Andhra Pradesh, 5 days later than the normal date, *viz*., 20 October. The northeast monsoon rainfall (October-December) over coastal Karnataka and Kerala was *excess*†; over Telangana, Rayalaseema, Tamil Nadu, north interior Karnataka and south interior Karnataka was *normal* and over coastal Andhra Pradesh and Lakshadweep was *deficient*. Northeast monsoon rains ceased in Tamil Nadu, Kerala and adjoining areas of Karnataka and Andhra Pradesh on 27 December 2002. Normally it ceases by the end of December.

Rainfall activity was subdued in other parts of the country except in east Madhya Pradesh.

2. Seasonal rainfall (October-December)

Seasonal rainfall in 36 meteorological sub-divisions was *excess* in 3, *normal* in 9, *deficient* in 11 and *scanty* in 13.

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

3. Monthly features

3.1. *October*

3.1.1. *Withdrawal of southwest monsoon*

Southwest monsoon withdrew from the central parts of the country by 3 October (more or less in the normal date), northeastern states by 17 October, (4-5 days delay over the extreme northeast). The withdrawal completed from most of the regions north of Lat. 15° N by 21 October (6-7 days delay). It withdrew from the entire country on 25 October (10 days delay) with the simultaneous commencement of northeast monsoon rains over Tamil Nadu, Kerala and adjoining states of Karnataka and Andhra Pradesh.

3.1.2. *Commencement of northeast monsoon rains*

Northeast monsoon rains commenced over Tamil Nadu, Kerala and adjoining areas of Karnataka and Andhra Pradesh states on 25 October, 5 days later than the normal date, *i.e*., 20 October.

3.1.3. *Storms/depressions*

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

3.1.3.1. *Depression over the Bay of Bengal (22-23 October)*

Under the influence of a trough of low and upper air cyclonic circulation, a low pressure area formed over southwest and adjoining west-central Bay on 21 morning. It became well marked on 22 morning and concentrated into a depression at 0900 UTC of 22 and lay centered near Lat. 13.5^{o} N/ Long. 81.5^{o} E. Moving in a northerly direction, it weakened into a low pressure area over west-central Bay of Bengal off Andhra Pradesh coast on 24 morning.

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

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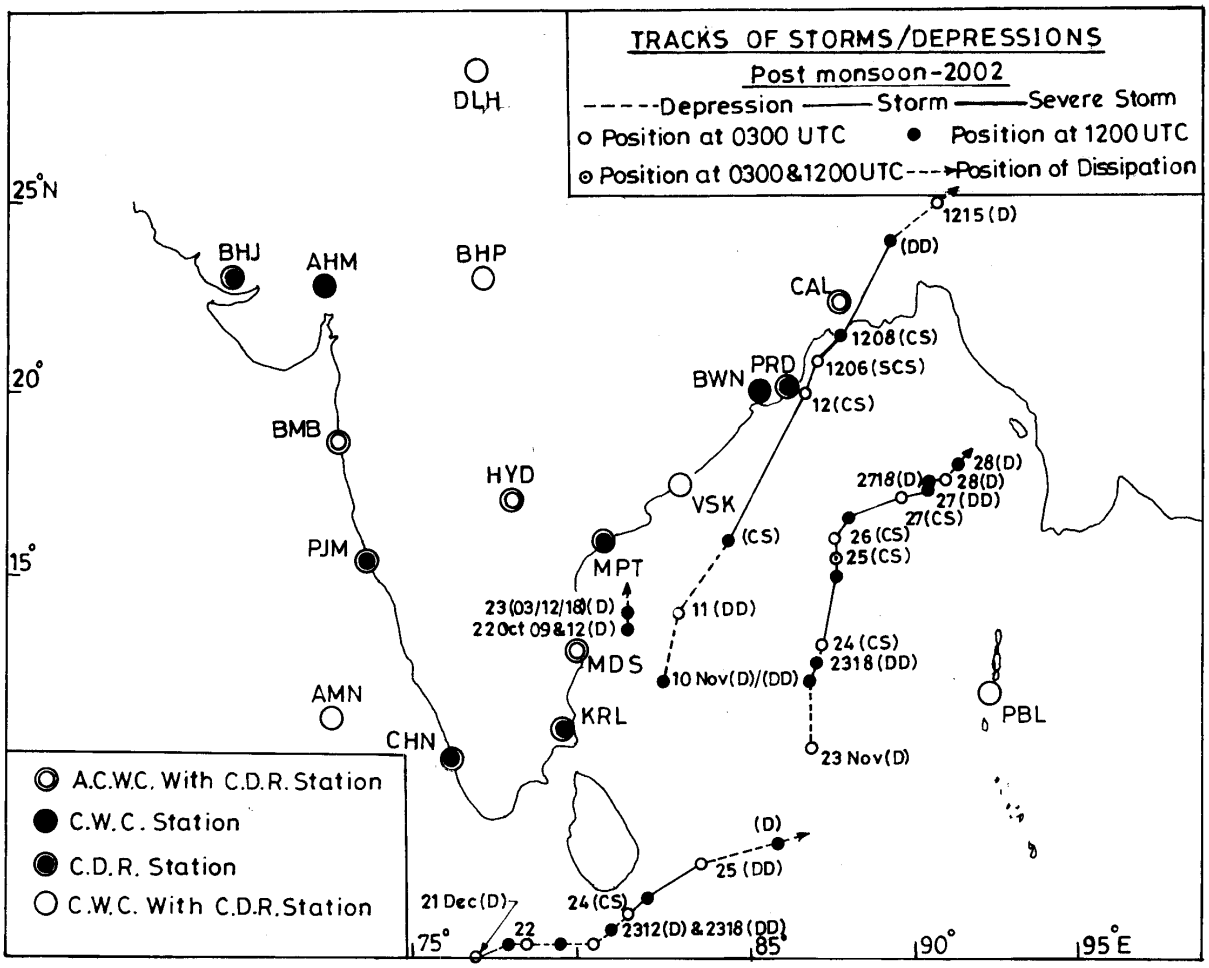

Fig. 1. Tracks of cyclonic storms during the period October to December 2002

Maximum intensity of the system as given by INSAT was T 2.0 from 1200 UTC of 22 to 0700 UTC of 23.

Since the system weakened over the sea area, no damage was reported. When the system moved inland as a low pressure area significant rainfall occurred in south coastal Andhra Pradesh. The chief rainfall amounts (cm) are given below :

26 Oct : Nellore & Gudur 9 each, Kandukur 7 and Srikalahasti 6.

27 Oct : Nellore 19, Kandukur 18 and Vinjamur 10.

3.1.4. *Weather and associated synoptic features*

Table 2 gives details of synoptic features for the month of October 2002.

Southwest monsoon was *vigorous* on 4 to 7 days in Telangana, coastal Karnataka, north interior Karnataka and Kerala and on 1 to 2 days in Arunachal Pradesh, Vidarbha, Rayalaseema and south interior Karnataka. It was *active* on 4 to 7 days in coastal Andhra Pradesh, Rayalaseema, coastal Karnataka, south interior Karnataka and Kerala and on 1 to 2 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Orissa and Telangana. Thereafter, northeast monsoon was active on 3 days in Kerala and on 1 day in south interior Karnataka.

Very Heavy rainfall occurred on 9 days in Kerala and on 1 to 3 days in Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, Rayalaseema, Tamil Nadu and north interior Karnataka. *Heavy* rainfall also occurred on 10 days in Kerala; on 3 to 7 days in coastal Andhra Pradesh, Telangana, Rayalaseema, Tamil Nadu, coastal Karnataka and south interior Karnataka and on 1 to 2 days

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (October-December 2002)

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	166	313	–47	320	268	20	148	201	–26	635	781	–19
2.	Arunachal Pradesh	66	179	–63	43	36	20	20	23	–14	129	238	–46
3.	Assam & Meghalaya	50	173	–71	59	29	107	7	11	–32	116	212	–45
4.	Naga., Mani, Mizo. and Tri.	20	158	–87	48	39	22	6	8	–22	75	205	–64
5.	Sub-Himalayan West Bengal & Sikkim	78	148	–47	5	24	–81	8	14	–44	91	186	–51
6.	Gangetic West Bengal	81	130	–38	49	24	104	**	6	–98	130	160	–19
7.	Orissa	60	117	–48	24	28	–14	0	5	–99	85	150	–43
8.	Jharkhand	76	83	–8	1	10	–84	1	4	–79	79	97	–19
9.	Bihar	37	68	–45	1	5	–75	1	3	–55	40	77	–48
10.	East Uttar Pradesh	23	50	–55	1	4	–82	3	6	–38	27	59	–55
11.	West Uttar Pradesh	8	39	–80	**	4	–95	10	7	49	18	49	–63
12.	Uttaranchal	21	58	–63	0	7	–100	3	18	–82	25	82	–70
13.	Haryana, Chandigarh & Delhi	3	18	–84	**	5	–98	11	7	52	13	29	–54
14.	Punjab	5	21	–74	0	5	–100	4	14	–71	10	40	–76
15.	Himachal Pradesh	14	44	–69	1	18	–92	1	42	–97	16	104	–84
16.	Jammu & Kashmir	14	29	–52	1	27	–98	13	59	–78	27	115	–76
17.	West Rajasthan	**	5	–94	3	3	–19	6	2	211	9	10	–11
18.	East Rajasthan	1	17	–95	1	7	–91	6	3	88	8	27	–71
19.	West Madhya Pradesh	8	32	–74	8	13	–40	1	6	–84	17	52	–67
20.	East Madhya Pradesh	67	39	69	6	12	–52	4	9	–60	76	60	26
21.	Gujarat region	**	23	–99	**	12	–97	**	2	–94	1	36	–99
22.	Saurashtra & Kutch	1	17	–97	1	12	–94	**	1	–50	2	30	–95
23.	Konkan & Goa	29	100	–71	1	27	–97	**	5	–98	30	132	–77
24.	Madhya Maharashtra	25	73	–66	5	28	–82	0	6	–100	30	107	–72
25.	Marathwada	28	65	–57	3	22	–88	0	7	–100	31	94	–67
26.	Vidarbha	36	52	–30	5	15	–70	0	8	–100	41	75	–45
27.	Chattisgarh	29	62	–53	**	8	–98	1	4	–83	30	74	–59
28.	Coastal Andhra Pradesh	177	195	–9	45	102	–56	1	25	–98	223	323	–31
29.	Telangana	109	86	26	1	19	–94	0	4	–100	110	109	0
30.	Rayalaseema	150	124	21	29	71	–59	5	26	–79	184	221	–17
31.	Tamil Nadu	217	183	18	138	165	–17	42	84	–51	396	432	–8
32.	Coastal Karnataka	426	187	128	30	71	–58	1	14	–92	457	272	68
33.	North interior Karnataka	136	99	37	4	29	–85	0	7	–100	141	135	4
34.	South interior Karnataka	182	145	25	21	50	–59	1	13	–92	203	208	–2
35.	Kerala	487	271	80	138	159	–13	2	46	–95	627	475	32
36.	Lakshadweep	178	153	16	53	116	–54	17	59	–70	249	328	–24

** Rainfall amount upto 0.4 mm.

in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland-Manipur-Mizoram-Tripura, Gangetic West Bengal, Orissa, Bihar, east Uttar Pradesh, west Madhya Pradesh, east Madhya Pradesh, Konkan & Goa, Vidarbha and Lakshadweep.

3.1.5. *Monthly rainfall*

Monthly rainfall was *excess* in 7, *normal* in 4, *deficient* in 10 and *scanty* in 15 meteorological sub-divisions. Rainfall was *excess* in east Madhya Pradesh, Telangana, Rayalaseema, coastal Karnataka, north interior Karnataka, south interior Karnataka and Kerala; *normal* in Jharkhand, coastal Andhra Pradesh, Tamil Nadu and Lakshadweep; *deficient* in Andaman & Nicobar Islands, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Orissa, Bihar, east Uttar Pradesh, Jammu & Kashmir, Marathwada, Vidarbha and Chattisgarh and *scanty* in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Uttaranchal, Haryana, Punjab, Himachal Pradesh, west Rajasthan, east Rajasthan, west Madhya Pradesh, Gujarat Region, Saurashtra & Kutch, Konkan & Goa and Madhya Maharashtra. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.1.6. *Temperature*

Heat wave conditions prevailed on 1 day each in some parts of west Rajasthan, east Rajasthan and Gujarat region. Day temperatures were *appreciably to markedly above normal* on 17 to 27 days in some parts of west Rajasthan, east Rajasthan, west Madhya Pradesh, Gujarat region and Saurashtra & Kutch; on 11 to 16 days in east Madhya Pradesh, Konkan & Goa, Madhya Maharashtra, Vidarbha and Chattisgarh; on 4 to 7 days in Assam & Meghalaya, east Uttar Pradesh, Uttaranchal, Himachal Pradesh, Jammu & Kashmir, Marathwada and Telangana and on 1 to 3 days in Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Orissa, Haryana, Punjab and coastal Karnataka. They were *appreciably to markedly below normal* on 3 to 5 days in some parts of Bihar, Haryana and Punjab and on 1 to 2 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Uttaranchal, Himachal Pradesh, Jammu & Kashmir, west Rajasthan, east Madhya Pradesh, Madhya Maharashtra, Vidarbha, coastal Andhra Pradesh, Telangana, Rayalaseema and south interior Karnataka. They were generally *normal* or *above normal* over the rest of the country on the remaining days.

The month's highest maximum temperature in the plains of the country was 42.6° C recorded at Jalore (west Rajasthan) on 8 October 2002.

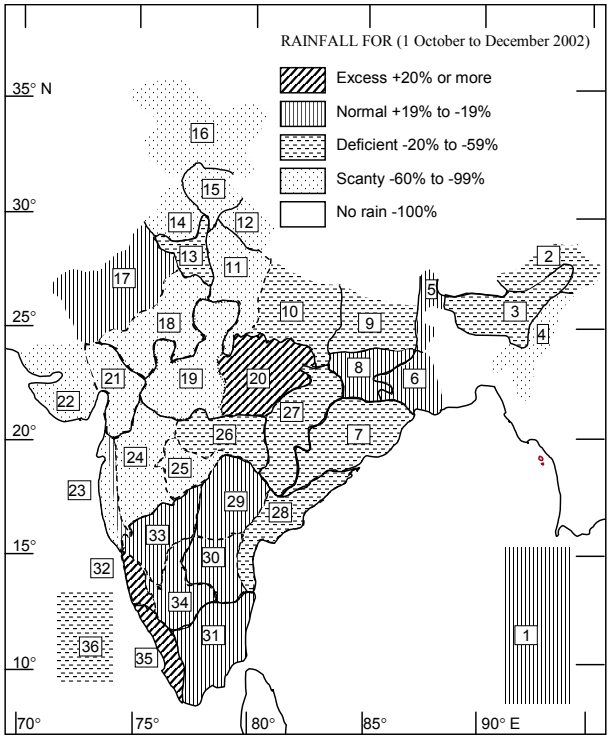

Fig. 2. Sub-divisionwise seasonal rainfall departure from normal (%) for Post monsoon season (October to December 2002). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	–19	**7**	–43	**13**	–54	**19**	–67	**25**	–67	**31**	–8
2	–46	**8**	–19	**14**	–76	**20**	26	**26**	–45	**32**	68
3	–45	**9**	–48	**15**	–84	**21**	–99	**27**	–59	**33**	4
4	–64	**10**	–55	**16**	–76	**22**	–95	**28**	–31	**34**	–2
5	–51	**11**	–63	**17**	–11	**23**	–77	**29**	0	**35**	32
6	–19	**12**	–70	**18**	–71	**24**	–72	**30**	–17	**36**	–24

Night temperatures were *appreciably to markedly below normal* on 4 to 6 days in some parts of Jharkhand, Gujarat region, Madhya Maharashtra, Marathwada and Vidarbha and on 1 to 3 days in some parts of Nagaland-Manipur-Mizoram-Tripura, Orissa, Bihar, Punjab, Jammu & Kashmir, east Rajasthan, west Madhya Pradesh, coastal Andhra Pradesh, Telangana and Rayalaseema. They were *appreciably to markedly above normal* on 18 to 21 days in some parts of west Rajasthan and east Rajasthan; on 8 to 12 days in some parts of Haryana, west Madhya Pradesh and east Madhya Pradesh; on 5 to 7 days in Gujarat Region, Saurashtra & Kutch and Madhya Maharashtra and on 1 to 2 days in Orissa, Jharkhand, east Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, Konkan & Goa, Marathwada, Vidarbha and Telangana. They were *below normal* over northern parts of the country on a few days in the first week of the month and

TABLE 2

Details of the weather systems during October 2002

S. No.	System	Period	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Storms/depressions*					
1.	Depression	22-23	Southwest and adjoining west-central Bay	Northerly	West-central and adjoining northwest Bay off coastal areas of Andhra Pradesh and Orissa	A trough of low at sea level extended from northeast Bay to west-central Bay off Andhra Pradesh coast on 19 & 20. Also a cyclonic circulation was seen over that area in the mid tropospheric levels on 20. Under the influence of the above trough of low and upper air cyclonic circulation, a low pressure area formed over southwest and adjoining west-central Bay on 21 morning. It became well marked on 22 morning and concentrated into a depression at 0900 UTC of 22 and lay centered near Lat. 13.5° N/ Long. 81.5° E. Moving in a northerly direction, it weakened into a low pressure area over west-central Bay off Andhra coast on 24 morning
(**B**)	*Low pressure area*					
1.	Low pressure area	10-15	Southeast and adjoining east-central Arabian Sea off Karnataka coast	Northerly	North Karnataka-Goa coast	The trough of low at sea level over southeast and adjoining central Arabian Sea off Kerala-Karnataka coasts from 5 and an embedded cyclonic circulation over Lakshadweep area on 9, organised into a low pressure area over southeast and adjoining east-central Arabian Sea off Karnataka coast on 10. It lay over north Karnataka-Goa coast on 15 and became less marked on the same day. Associated cyclonic circulation extending upto mid tropospheric levels traversed upto Chattisgarh and neighbourhood and became less marked on 18
(**C**)	*Western disturbances /eastward moving systems*					
1.	Induced cyclonic circulation upto mid tropospheric levels	2-7	Central Pakistan	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away northeastwards on 8
2.	Mid tropospheric levels	8-11	Do	Eastnorth-easterly	Eastern parts of Jammu & Kashmir and adjoining Uttaranchal	Moved away eastnortheastwards on 12
3.	Induced cyclonic circulation in lower levels	12-14	Central Pakistan and adjoining west Rajasthan	Do	Central parts of Rajasthan	Became less marked on 15
4.	Mid tropospheric levels	13-14	Jammu & Kashmir and neighbourhood	Do	Eastern parts of Jammu & Kashmir and adjoining parts of Himachal Pradesh and Uttaranchal	Moved away eastnortheastwards on 15
5.	Do	15-19	North Pakistan and adjoining Jammu & Kashmir	Easterly	Eastern parts of Jammu & Kashmir and neighbourhood	Moved away eastnortheastwards on 20
6.	Induced cyclonic circulation upto mid tropospheric levels	20-24	Central Pakistan and adjoining west Rajasthan	Eastnorth-easterly	Haryana and adjoining areas of west Uttar Pradesh and Uttaranchal	Moved away northeastwards on 25
7.	Mid tropospheric levels	26-27	North Pakistan and neighbourhood	Do	Jammu & Kashmir and neighbourhood	Moved away eastnortheastwards on 28
8.	Low pressure area	28 Oct-1 Nov	Do	Do	Do	Moved away eastnortheastwards on 2 Nov

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**D**)	*Other cyclonic circulations*					
1.	Lower levels	8	North interior Karnataka, adjoining south Madhya Maharashtra and Telangana	Stationary	*In situ*	Became less marked on 9
2.	Do	4-6	Gangetic West Bengal and neighbourhood	Easterly	Bangladesh and neighbourhood	Became less marked on 7
3.	Mid tropospheric levels	7-8	Central parts of Uttar Pradesh	Do	East Uttar Pradesh and neighbourhood	Became less marked on 9
4.	Lower levels	19-20	West Bengal & Sikkim	Do	Bangladesh and neighbourhood	Became less marked on 21
(**E**)	*Troughs in easterly*					
1.	Trough of low at sea level	5-8	Southeast and adjoining central Arabian Sea off Kerala-Karnataka coast	Westerly	Southwest Arabian Sea	Became less marked on 9
2.	Trough in the lower levels	29	Southeast Bay	Do	Do	It was seen as cyclonic circulation extending upto 2.1 km a.s.l. over Sri Lanka and adjoining areas of south Tamil Nadu and southwest Bay on 30 & 31 October. It lay as a trough over Lakshadweep area and adjoining southeast Arabian Sea from 2 to 4 and over southeast Arabian Sea on 5 and 6. A trough from this system in the lower levels extended northeastwards to west-central Bay off coastal areas of Tamil Nadu and of Andhra Pradesh on 31 October. It further extended northwards to Telangana on 1 November
(**F**)	*Other troughs*					
1.	Upper air trough at mid tropospheric level	1-4	Long. 70° E, north of Lat. 21° N	Eastnortheasterly	Long. 73° E, north of Lat. 20° N	Moved away on 5
2.	Trough of low at sea level	9-15	Southwest Bay off Tamil Nadu coast	Northerly	West-central Bay and adjoining coastal Andhra Pradesh	Embedded cyclonic circulation at mid tropospheric level was observed on 13 and 14
3.	Trough at mid tropospheric level	16-18	East Madhya Pradesh to Lakshadweep area through interior parts of Maharashtra and Karnataka	Northeasterly	East Uttar Pradesh to north interior Karnataka through Vidarbha	Became less marked on 19
4.	Trough of low at sea level	17-20	South Gujarat coast to Lakshadweep area	Stationary	South Maharashtra to Lakshadweep area	Became less marked on 21

in some parts of peninsular India in the last week of the month.

The month's lowest minimum temperature in the plains of the country was 12.2° C recorded at Sarsawa (west Uttar Pradesh) on 25 October 2002.

3.1.7. *Disastrous weather events and associated damage*

According to press reports, during the month, heavy rain, thunderstorms and lightning took a toll of 68 people (39 in Tamil Nadu, 23 in Kerala, 4 in West Bengal and 1 each in Madhya Maharashtra and Assam).

Historical and valuable paintings by Italian painter *Antonio Moscheri* was partly damaged as lightning struck the St. Aloysius Chapel in Mangalore city on 2 October 2002. Moderate damage was also caused to crops, houses and roads in Karnataka due to heavy rains during the month.

3.2. *November*

3.2.1. *Storms/depressions*

During the month of November, one severe cyclonic storm and one cyclonic storm formed over the Bay of Bengal. Details are presented below:

3.2.1.1. *Severe cyclonic storm over the Bay of Bengal (10-12 November)*

Under the influence of a trough, a low pressure area formed over southeast and adjoining southwest Bay in the morning of 8 November. It concentrated into a depression and lay centered near Lat. 12.0° N/ Long. 82.5° E at 0300 UTC of 10. It intensified into a deep depression over the same region at 1200 UTC of 10. Moving in a northnortheasterly direction it intensified into a cyclonic storm and lay centered near Lat. 16.0^{o} N/ Long. 84.5° E at 1200 UTC of 11. Continuing its northnortheasterly movement, it further intensified into a severe cyclonic storm at 0600 UTC of 12 and lay centered near Lat. 21.0° N/ Long. 87.5° E, but subsequently weakened into a cyclonic storm at 0800 UTC of 12 and lay centered near Lat. 21.7° N/ Long. 88.3° E and crossed West Bengal coast, south of Kolkata near Sagar Island around 0900 UTC of 12. It further moved in a northeasterly direction and weakened into a deep depression at 1200 UTC of 12 and lay centered near Lat. 24.0° N / Long. 90.0° E. Further weakened into a depression, it lay near centered Lat. 25.0° N / Long. 91.5° E at 1500 UTC of 12. It rapidly weakened into a low pressure area at 0300 UTC of 13 and lay over Bangladesh and neighbourhood.

Maximum intensity of the system as given by METSAT (KALPANA I) was T 4.5 (77 kts) at 0600 UTC to 0700 UTC of 12. No eye was noticed by METSAT Cloud Imagery. The estimated lowest central pressure of the system was 990 hPa at 0300 UTC of 12. Maximum estimated wind speed was 77 kts.

Heavy to *very heavy* rainfall occurred at a few places in coastal Orissa on 11 and Gangetic West Bengal on 12. *Heavy* rainfall occurred at isolated places in coastal Andhra Pradesh on 10 & 11.

Principal amounts of rainfall (cm) are :

10 Nov : Kavali 9, Gudur 5 and Nellore 4.

11 Nov : Paradip 25, Puri & Sulurpet 6 each, Balasore 5, Tada 4, Bhubaneswar and Cuttack 3 each.

12 Nov : Canning Town 11, Basirhat 8, Contai and Digha 7 each, Kolkata (ALP and DUM) 6 each, Durgachak, Magra and Uluberia 5 each, Diamond Harbour and Krishnanagar 4 each.

The system did not cause much damage over the land area. As per the report given by Department of Relief, Government of West Bengal, 3 fishermen died (in south 24 Paraganas district). Seventy two persons were missing in Howrah and 24 Paraganas districts. Eleven trawlers / boats were also reported to have capsized in those districts.

As per report of CWC Visakhapatnam, 11 crew were missing as a fishing trawler capsized near Paradip on 12. As per press reports, damage occurred in Bhadrak and Jagatsinghpur districts of Orissa. A number of thatched houses were damaged in Paradip port. Two trawlers were damaged in Bhadrak district.

3.2.1.2. *Cyclonic storm over the Bay of Bengal (23-28 November)*

Under the influence of sea level trough, a low pressure area formed over southeast Bay and adjoining south Andaman Sea in the morning of 22 November. On the evening of 22, it became a well marked low pressure area over the same region. It concentrated into a depression by 0300 UTC of 23 and lay centered near Lat. 10.0^{o} N/ Long. 87.0° E. Moving in a northerly direction, it intensified into a deep depression near Lat. 12.5° N/ Long. 87.0° E at 1800 UTC of 23 and further intensified into a cyclonic storm and lay centered near Lat. 13.0° N/ Long. 87.5° E at 0300 UTC of 24. Thereafter, it moved in a northnortheasterly direction for some time, then recurved into an eastnortheasterly direction and

TABLE 3

Details of the weather systems during November 2002

S. No.	System	Period	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	10-12	Southeast and adjoining southwest Bay	Northerly	Bangladesh and neighbourhood	Under the influence of a trough, a low pressure area formed over southeast and adjoining southwest Bay on 8 morning. It concentrated into a depression near Lat. 12.0° N / Long. 82.5° E at 0300 UTC of 10. It intensified into a deep depression over the same region at 1200 UTC of 10. Moving in a northnortheasterly direction it intensified into cyclonic storm and lay centered near Lat. 16.0° N / Long. 84.5° E at 1200 UTC of 11. Subsequently, moving in a northnortheasterly direction, it further intensified into a severe cyclonic storm at 0600 UTC of 12 and lay centered near Lat. 21.0° N / Long. 87.5° E. and rapidly weakened into a cyclonic storm at 0800 UTC of 12 and lay centred near Lat. 21.7° N / Long. 88.3° E and crossed West Bengal coast south of Kolkata near Sagar Island around 0900 UTC of 12. It further moved in a northeasterly direction and weakened into a deep depression at 1200 UTC of 12 and lay centered near Lat. 24.0° N / Long. 90.0° E. Weakening further into a depression, it lay centred near Lat. 25.0° N / Long. 91.5° E at 1500 UTC of 12. It rapidly weakened into a low pressure area at 0300 UTC of 13 and lay over Bangladesh and neighbourhood
2.	Cyclonic storm	23-28	Southeast Bay and adjoining south Andaman Sea	Northerly	Northeast Bay	A trough in the lower level was observed over Andaman Sea and neighbourhood on 14. It persisted there upto 19. On 20, it lay over southeast Bay and on 21 it lay over southeast Bay and adjoining Andaman Sea. Under its influence a low pressure area formed over southeast Bay and adjoining south Andaman Sea in the morning of 22. On the evening of 22, it became a well marked low pressure area over the same region. It concentrated into a depression by 0300 UTC of 23 and lay centred near Lat. 10.0° N/ Long. 87.0° E. Moving in a northerly direction, it intensified into a deep depression centred near Lat. 12.5° N/ Long. 87.5° E at 1800 UTC of 23 and further into a cyclonic storm centred near Lat. 13.0° N/ Long. 87.5° E at 0300 UTC of 24. Thereafter, it moved in a northnortheastely direction for some time, then recurved into an eastnortheasterly direction and subsequently weakened into a deep depression and lay centred near Lat. 17.2° N/ Long. 91.0° E at 1200 UTC of 27. It further weakened into a depression at 0300 UTC of 28 and lay centred near Lat. 17.5° N/ Long. 91.5° E. On 29 morning, it weakened into a low pressure area over northeast and adjoining east-central Bay
(**B**)	*Western disturbances /eastward moving systems*					
1.	Mid tropospheric levels	2-4	North Pakistan and adjoining Jammu & Kashmir	Eastnorth-easterly	Himachal Pradesh and adjoining Uttaranchal	Moved away on 5
2.	Do	4-9	Do	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away on 10

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Mid tropospheric levels	4-9	Central Pakistan and adjoining west Rajasthan	Northeasterly	Uttaranchal and neighbourhood	Moved away on 10
4.	Do	7-14	North Pakistan	Eastnorth-easterly	Uttaranchal and neighbourhood	Moved away on 15
5.	Lower levels	13-20	Do	Eastnorth-easterly	Himachal Pradesh and neighbourhood	Moved away on 21
6.	Do	13-15	East Rajasthan and neighbourhood	Do	Uttar Pradesh and neighbourhood	Became less marked on 16
7.	Mid tropospheric levels	22-28	North Pakistan and adjoining Jammu & Kashmir	Easterly	Jammu & Kashmir and neighbourhood	A trough extended southsouthwestwards from this system to northeast Arabian Sea on 24 and 25. It became less marked on 26
8.	Do	27-29	North Pakistan	Eastnorth-easterly	Jammu & Kashmir and neighbourhood	Moved away on 30
9.	Do	30 Nov-4 Dec	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away on 5 December
(**C**)	*Other cyclonic circulations*					
1.	Mid tropospheric levels	4-6	Gangetic West Bengal and adjoining areas	Stationary	*In situ*	Became less marked on 7
2.	Lower levels	10-12	Konkan & Goa and adjoining Madhya Maharashtra	Northeasterly	North Madhya Maharashtra	Became less marked on 13
3.	Lower tropospheric levels	11-12	Saurashtra & Kutch and neighbourhood	Do	West Madhya Pradesh and neighbourhood	Became less marked on 13
(**D**)	*Troughs in easterly*					
1.	Lower levels	1-5	South Arabian Sea	Westerly	Southwest Arabian Sea	Moved away westwards
2.	Do	1-10	Andaman Sea	Do	Comorin area	A trough from this system extended northwards to Myanmar on 2 and to northeast Bay on 3
3.	Do	13-30	Southwest Bay	Do	Southwest Arabian Sea	Moved away westwards
4.	Do	14-25	Lakshadweep area off Kerala-Karnataka coast	Do	Do	Do
5.	Do	30 Nov-11 Dec	Southeast Arabian Sea	Do	Southwest Arabian Sea	Became less marked on 12 Dec

TABLE 4

Details of the weather systems during December 2002

S. No.	System	Period	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Cyclonic storms/depressions*					
1.	Cyclonic storm	21-25	Off southwest coast of Sri Lanka over extreme northern parts of the equatorial Indian Ocean	Easterly to northeasterly and then eastnortheasterly	Southwest and adjoining southeast Bay of Bengal	In an equatorial trough, a low pressure area developed off southwest coast of Sri Lanka over extreme northern parts of the equatorial Indian Ocean in the evening of 20. It concentrated into a Depression at 0300 UTC of 21 and lay centred near Lat. 4.0° N / Long. 77.0° E. Initially moving in easterly direction and then in a northeasterly direction, it intensified into a cyclonic storm and lay centred near Lat. 5.5° N / Long. 81.5° E at 0300 UTC of 24. It further moved in a northeasterly direction and weakened into a deep depression at 0300 UTC of 25 near Lat. 7.0° N / Long. 83.5° E. Subsequently, moving in an eastnortheasterly direction, it weakened into a depression at 1200 UTC of 25 near Lat. 7.5° N / Long. 86.0° E. It further weakened into a low pressure area after 1500 UTC of 25 over southwest and adjoining southeast Bay of Bengal
(**B**)	*Western disturbances /eastward moving cyclonic circulations*					
1.	Mid tropospheric level	3-6	North Pakistan and adjoining Jammu & Kashmir and Punjab	Easterly	North Rajasthan and adjoining Punjab and Haryana	Moved away on 7
2.	Do	6-13	Jammu & Kashmir and adjoining north Pakistan	Eastnorth-easterly	Uttaranchal and neighbourhood	Moved away on 14
3.	Do	14-21	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away on 22. A trough from this system extended southsouthwestwards to northeast Arabian Sea from 14 to 17
4.	Do	22-26	North Pakistan and adjoining Jammu & Kashmir	Do	Haryana and neighbourhood	Became less marked on 27. A trough was seen extending from this system to northeast Arabian Sea on 23 and to east Madhya Pradesh on 24. It extended upto north Orissa with an embedded cyclonic circulation over central parts of Uttar Pradesh and adjoining north Madhya Pradesh on 25
5.	Do	25-30	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away on 31
6.	Do	31 Dec-4 Jan	North Pakistan and adjoining Jammu & Kashmir and Punjab	Do	Northern parts of Jammu & Kashmir	Moved away on 5 Jan
(**C**)	*Western disturbance as induced systems*					
1.	Induced low pressure area	30-31	South Pakistan and adjoining west Rajasthan	Eastnorth-easterly	Northwest Madhya Pradesh and adjoining east Rajasthan	Associated cyclonic circulation extended upto mid tropospheric level. It lay over east Uttar Pradesh and neighbourhood with a trough aloft on 1 Jan and became less marked on 2 Jan

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**D**)	*Other cyclonic circulations*					
1.	Lower tropospheric level	20	Sub-Himalayan West Bengal & Sikkim	Stationary	*In situ*	-
(**E**)	*Troughs in easterly*					
1.	Trough in lower level	29 Dec-16 Jan	Andaman Sea	Westerly	Southwest Arabian Sea	Became less marked on 17 Jan
2.	Trough in lower level	2-11	Andaman Sea	Do	Southwest Arabian Sea	Became less marked on 12
3.	Do	6-9	Lakshadweep area and adjoining southeast Arabian Sea	Westerly	Central parts of south Arabian Sea	Became less marked 10
4.	Do	9-24	Andaman Sea	Westerly	Southwest Arabian Sea	Became less marked on 25
5.	Do	9-22	Southeast Bay off Andhra-Tamil Nadu coasts	Westerly	Southwest Arabian Sea	Became less marked on 23
6.	Do	12-17	Lakshadweep area	Westerly	Southwest Arabian Sea	Became less marked on 18
7.	Do	21-24	South Andaman Sea	Do	Southeast Bay	Merged with the DD on 25

subsequently weakened into a deep depression near Lat. 17.2° N/ Long. 91.0° E at 1200 UTC of 27. It further weakened into a Depression at 1800 UTC of 27 and lay centred near Lat. 17.5° N/ Long. 91.0° E. Moving in a northeasterly direction, it maintained its intensity as a depression till 1200 UTC of 28. On 29 morning, it weakened into a low pressure area over northeast Bay and adjoining east-central Bay.

The system was tracked all through with the help of METSAT (KALPANA I).

The maximum 'T' number reported by METSAT(KALPANA I) was T 2.5 (35 kts) from 0300 UTC to 0900 UTC of 24 and from 0300 UTC of 26 to 0300 UTC of 27.

As the system recurved in an eastnortheasterly direction and weakened over the Ocean, it did not cause any weather or damage over the country.

3.2.2. *Weather and associated synoptic features*

Details of synoptic features for the month of November 2002 are given in Table 3.

Northeast monsoon was *active* on 2 to 3 days in Rayalaseema and Kerala. *Very heavy* rainfall occurred on 1 to 3 days in Andaman & Nicobar Islands, Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Orissa, coastal Andhra Pradesh, Tamil Nadu and Kerala. *Heavy* rainfall also occurred on 11 days in Tamil Nadu; on 4 to 7 days in Andaman & Nicobar Islands, coastal Karnataka and Kerala and on 1 to 2 days in Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Gangetic West Bengal, Orissa, Vidarbha and coastal Karnataka.

3.2.3. *Monthly rainfall*

Monthly rainfall was *excess* in 5, *normal* in 4, *deficient* in 7 and *scanty* in 18 meteorological sub-divisions. There was no rain in the remaining 2 meteorological sub-divisions. It was *excess* in Andaman & Nicobar Islands, Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura and Gangetic West Bengal; *normal* in Orissa, west Rajasthan, Tamil Nadu and Kerala; *deficient* in west Madhya Pradesh, east Madhya Pradesh, coastal Andhra Pradesh, Rayalaseema, coastal Karnataka, south interior Karnataka

TABLE 5

Principal amounts of rainfall (cm) (3 cm and above)

Date	October	November	December
(1)	(2)	(3)	(4)
1.	Bhalukpong 11, Thiruvalla 8, Alathur 7, Jalpaiguri 4, Dibrugarh 3	Chennai 20, Cuddalore 17, Pondicherry 15, Red Hills 12, Karaikal 7, Nancowry 4	Nil
2.	Chalakudy 9, Panambur 4, Thiruvananthapuram & Pamban 3 each	Chidambaram 13, Chennai 8, Parangipettai, Begur & Chennai 7 each, Madurai 5, Basaralu 6, Bangalore & Mulki 3 each	Nil
3.	Belgaum 4, Kolkata, Wada, Panhala, Nanguneri & Poondi 3 each	Shriharikota 11, Balehonnur 5, Puttur, Mangalore, Agumbe & Pamban 4 each, Thiruvananthapuram 3	Car Nicobar 3
4.	Thrissur & Kodungallur 16 each, Punalur 6, Trichur, Udumalpet & Satyamangalam 5 each, Mangalore 4, Alapuzha, Uthagamandalam & Manamadurai 3 each	Mayiladuthurai 11, Dholai 3	Hut Bay 5, Port Blair & Maya Bandar 4 each
5.	Punalur & Kollam 15 each, Tiruthuraipoondi 5, Kodumudi & Cial Cochi 4 each, Kumbakonam 3	Maya Bandar 10, Ramanathapuram 9, Pamban 8, Kumarakoti & Tiruchendur 7 each, Chennai 5, Car Nicobar 3, Karaikal 3	Nil
6.	Mayanur 9, Melur 8, Namakkal & Sankarankoil 7 each, Thiruvananthapuram & Coimbatore 6 each, Kondul & Pondicherry 5 each, Kodaikanal & Adirampattinam 4 each, Agathi 3	Manjeri 12, Sankarankoti 10, Gudur, Piravom & Kanjirapalli 7 each, Kottayam 6, Kondul 3	Nil
7.	Uthagamandalam & Virudhunagar 5 each, Natham, Madurai, Periyakulam & Mannargudi 4 each, Dindigul, Shenkottah, Thiruvananthapuram & Kondul 3 each	Barnagar 35, Konni 13, Arani & Thammanpatti 10 each, Ongole 9, Kandukur & Piravom 8 each, Karur Paramathy & Kottayam 6 each, Chennai 5, Kakinada, Machilipatnam & Thiruvananthapuram 4 each, Tuni & Kakinada 3 each	Thiruvarur 18, Chidambaram 15, Sirkali & Cuddalore 11 each, Pondicherry 10, Gingee & Nagapattinam 8 each, Pamban, Karaikal & Vedaranniyam 7 each, Thanjavur 5, Adirampattinam & Tirupathi 4 each, Chennai 3
8.	Thiruvananthapuram 8, Tiruchendur 7, Arantangi 5, Sultanpur & Muthupet 4 each, Allahabad, Punalur, Mettupatti, Namakkal, Sivakasi, Kondul & Chatnag 3 each	Kanyakumari 10, Ramanathapuram 9, Thodupuzha & Kavali 8 each, Angadipuram 7, Chennai 5, Palayamkottai 4	Tirupathi 4, Hut Bay, Arogyavaram, Kodaikanal & Mudibidere 3 each
9.	Kottayam 13, Thiruvalla 12, Puttur 11, Thiruvananthapuram 10, Galia, Mulki, Cial Cochi & Minicoy 9 each, Jaunpur & Cannur 8 each, Kozhikode 7, Machilipatnam & Tondi 6 each, Adirampattinam & Patna 5 each, Honavar, Gaya & Srimushnam 4 each, Kakinada, Kondul, Chennai & Khanapura 3 each	Gudur 14, Ponneri 12, Senkottah 11, Aryankavu 10, Port Blair & Alapuzha 9 each, Maya Bandar, Chennai, Kandukur & Kottayam 8 each, Nellore 6, Karaikal 4, Pondicherry, Bapatla, Kanyakumari, Cuddalore & Thiruvananthapuram 3 each	Nil
10.	Konni 18, Mudubidre 12, Angadipuram 11, Kodungallur 10, Mandya, Dharmasthala & Thiruvaiyyur 9 each, Karkala 8, Maddur 7, Kozhikode 6, Alapuzha, Nellore & Honavar 5 each, Bangalore & Kavali 4 each, Chitradurga, Cuddalore, Mangalore & Cochi 3 each	Senkottah 22, Ponneri 11, Maya Bandar 10, Kavali & Chennai 9 each, Mancompu 8, Tada 7, Port Blair & Nellore 4 each, Punalur, Kodaikanal, Tuticorin, Alapuzha & Tirupathi 3 each	Pamban 3
11.	Gargoti 23, Lokapura 13, Lingsugur 12, Alland & Polur 10 each, Nalwatwad 9, Kankavali & Polavaram 7 each, Kashinagar & Guhagar 6 each, Anantpur, Ratnagiri, Bangalore & Paradip 4 each, Gopalpur & Karipur 3 each	Manamadurai 10, Sivaganga 8, Pamban 5, Port Blair & Kolhapur 4 each, Ratnagiri & Tondi 3 each	Pamban 4, Adirampattinam 3

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
12.	Hosdurg 15, Kannur 13, Kudulu & Mulki 12 each, Kundapura & Mangalore 11 each, Mudibidere 10, Panambur 9, Udupi 8, Pargi, Kozhikode & Kakinada 7 each, Kalamb, Narsapur & Gopalpur 6 each, Karwar, Chennai & Cochi 5 each, Kurnool 5	Chicholi 46, Bhainsdehi 34, Betul 29, Paradip 25, Bhopal 13, Vidisha 14, Narsinghpur 15, Motala 8, Williamnagar 7, Puri, Alipingal & Subraom 6 each, Car Nicobar, Agartala, Digha & Balasore 5 each, Cuttack, Canning Town & Bhubaneswar 3 each	Maya Bandar 3
13.	Honavar 26, Kudulu 25, Kasargode 24, Karwar 19, Hosdurg 17, Taliparamba 13, Chhatrapur & Panambur 12 each, Kozhikode 11, Irikkur 10, Cochi 9, Palaru Bridge 8, Cannur 7, Gopalpur & Belgaum 6 each, Kalingapatnam & Jammu 5 each, Nizamabad, Kolkata & Balasore 3 each	Shillong 13, Canning Town 11, Agartala 9, Bhograi 8, Williamnagar & Digha 7 each, Kolkata 6, Guwahati, Dharampur & Belonia 5 each, Kohima & Diamond Harbour 4 each, Tezpur & Imphal 3 each	Nil
14.	Kannur 37, Thalassery 36, Hosdurg & Irikkur 16 each, Taliparamba 13, Panambur 11, Suryapet 9, Jammu, Paralakhemundi & Kurnool 8 each, Metapalli 7, Gaya, Machilipatnam & Kozhikode 5 each, Kothagudam, Kottayam, Ongole & Ratnagiri 4 each, Agartala & Paradip 3 each	Punalur 11, Kherunighat 9, Thiruvananthapuram 8, Roing 4, Cochi & Namsai 3 each	Nancowry 3
15.	Kunnamkulam 21, Peermade 14, Quilandy 13, Alapuzha 12, Munnar 10, Thiruvananthapuram & Kozhikode 9 each, Machilipatnam & Kodungallur 8 each, Bapatla 7, Kurnool & Valparai 5 each, Maya Bandar, Nagapattinam & Chitradurga 4 each	Senkottah 9, Sankaridurg 7, Bhalukpong 5	Kondul & Minicoy 4 each
16.	Bapatla 8, Tandur, Kasargode & Kudulu 7 each, Honavar & Ongole 6 each, Maya Bandar, Kurnool, Belgaum & Minicoy 5 each, Karwar, Solapur Hyderabad & Kolhapur 4 each, Ratnagiri, Vita, Machilipatanam & Bangalore 3 each	Nil	Nil
17.	Hingoli & Pathri 10 each, Gevrai, Thanjavur, Peermade, Chincholi & Ranchi 7 each, Narkhed, Katangi, Honavar, Parbhani & Thiruvananthapuram 6 each, Shegaon, Yeotmal & Akola 5 each, Nagrakata, Poltangi, Bhira, Car Nicobar, Karwar, Minicoy & Raipur 4 each, Khonsa, Imphal, Pune, Nancowry & Madurai 3 each	Nil	Nil
18.	Harinkhola & Mul 9 each, Suri, Chennai & Satna 8 each, Vellore, Kondul & Dhaniakhali 7 each, Panposh, Gyanpur, North Lakhimpur & Tambaram 6 each, Hazaribagh, Bankura, Maya Bandar & Varanasi 5 each, Allahabad 4, Kolkata, Ranchi, Mana AP & Daltonganj 3 each	Nancowry 5, Minicoy 3	Nil
19.	Contai 12, Manmathanagar 11, Aranthangi 9, Magra 8, Perungallur & Chouldhowaghat 7 each, Diamond Harbour, Dillighat, Nimapada & Kolkata 6 each, Thiruvananthapuram & Bhubaneswar 5 each, A P Ghat 4, Adirampattinam, Nancowry, North Lakhimpur & Narsapur 3 each	Nancowry 9, Maya Bandar & Kanyakumari 6 each, Karaikal 5, Kondul 4, Nagapattinam & Palayamkottai 3 each	Nil
20.	Lengpui & Tondi 10 each, Perundurai 8, Maddur 7, Amraghat & Mandya 6 each, Imphal, Karaikal & Cochi 4 each, Nagrakata, Trichy Town & Bangalore 3 each	Ramanathapuram 12, Nancowry 9, Nagapattinam 8, Palayamkottai & Karaikal 6 each, Roing, Majbat & Pamban 3 each	Nil
21.	Tyagharthy 7, Pamban 4, Bihubar 3	Nancowry 13, Nagapattinam 9, Thalassery 8, Car Nicobar, Kondul & Karaikal 3 each	Nil

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
22.	Kondul & Khed 5 each, Karjat 3	Udaipur 12, Kudulu & Nagarcoil 9 each, Chalakudy 8, Port Blair & Nancowry 7 each, Kanyakumari & Mulky 5 each, Hut Bay & Karkala 4 each, Panambur 3	Nil
23.	Alapuzha 10, Thodupuzha & Aryankavu 7 each, Champasarai 6, Kottayam 5, Nagrakata, Jawahar & Cochi 3 each	Kumarakom 13, Thiruvananthapuram & Mancompu 9 each, Alapuzha & Kozhikode 6 each, Maya Bandar 4, Hut Bay 3	Kondul 5
24.	Aryankavu 15, Nanguneri 7, Tadong 6, Nancowry & Jalpaiguri 4 each	Hut Bay 3	Nil
25.	Muthupet 8, Kottayam & Mettupatti 7 each, Nancowry 4, Gangtok, Madurai & Pamban 3 each	Agumbe 5	Nil
26.	Srimushnam 16, Kavali 13, Peermade & Nellore 9 each, Arani 7, Tirupathi 5, Visakhapatnam & Kozhikode 4 each, Kakinada 3	Kanyakumari 3	Nil
27.	Nellore 19, Kandukur 18, Tirupur 14, Atmakur 13, Srimushnam 11, Kavali & Tirupattur 10 each, Adirampattinam 8, Udayagiri 7, Ongole 4, Nancowry & Chennai 3 each	Nil	Port Blair 4
28.	Avinashi 15, Covelang & Pudukottai 11 each, Tirumangai & Sivagangai 8 each, Mannargudi & Coimbatore 7 each, Madurai 6, Chennai 5, Panambur 4, Nellore 3	Nil	Nil
29.	Periyakulam 11, Bellur & Erode 8 each, Sankaridurg 7, Panambur 3	Nil	Nil
30.	Hiriyur 11, Saltar 9, Natham 8, Aryankavu, Bhukkapatna, Sivakasi, Yagatti & Chennai 7 each, Chitradurga 5, Panjim & Bangalore 4 each, Nellore, Tiruchirapalli & Tirupathi 3 each	Nil	Nancowry 9, Kondul 3
31.	Mayiladuthurai 31, Palayamkottai 24, Thiruvarur 15, Nannilam & Karaikal 13 each, Parangipettai 12, Pamban 10, Nagapattinam & Konni 9 each, Vegati 5, Kumta, Belur & Thiruvananthapuram 3 each	–	Guhla & Narmal 3 each

and Lakshadweep; *scanty* in Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, west Uttar Pradesh, Haryana, Himachal Pradesh, Jammu & Kashmir, east Rajasthan, Gujarat region, Saurashtra & Kutch, Konkan & Goa, Madhya Maharashtra, Marathwada, Vidarbha, Chattisgarh, Telangana and north interior Karnataka and there was no rain in Uttaranchal and Punjab. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.2.4. *Temperature*

Night temperatures were *appreciably to markedly below normal* on 5 to 6 days in some parts of Orissa, Jharkhand, Gujarat region and coastal Andhra Pradesh and on 1 to 3 days in Uttaranchal, Haryana, Punjab, Madhya Maharashtra, Marathwada, Telangana, Rayalaseema, Tamil Nadu, north interior Karnataka and south interior Karnataka. They were *appreciably to markedly above normal* on 27 days each in some parts of west Rajasthan, east Rajasthan and west Madhya Pradesh; on 15 to 18 days in some parts of Nagaland-Manipur-Mizoram-Tripura, east Uttar Pradesh, Haryana, east Madhya Pradesh and Saurashtra & Kutch; on 4 to 9 days in Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Bihar, west Uttar Pradesh, Punjab, Himachal Pradesh, Gujarat region and Madhya Maharashtra and on 1 to 3 days in Assam & Meghalaya, Orissa, Jharkhand,

Uttaranchal, Jammu & Kashmir, Konkan & Goa, Marathwada, Vidarbha, Chattisgarh, coastal Andhra Pradesh, Telangana, Rayalaseema, Tamil Nadu and coastal Karnataka and were generally *above normal or normal* over the rest of the country on the remaining days.

Month's lowest minimum temperature in the plains of the country was 3.6° C recorded at Adampur (Punjab) on 30 November 2002.

3.2.5. *Disastrous weather events and associated damage*

According to press reports, 23 people (20 in Tamil Nadu and 3 in Maharashtra) lost their lives due to heavy rains.

Sixty six trawlers were drowned near Sagar Islands and Sunderban area and thus around 460 fishermen were reported to be missing.

3.3. *December*

3.3.1. *Storms/depressions*

During the month, only one cyclonic storm formed over the Bay of Bengal. Details are given below :

3.3.1.1. *Cyclonic storm over the Bay of Bengal (21-25 December)*

In an active equatorial trough, a low pressure area developed off southwest coast of Sri Lanka over extreme northern parts of the Indian Ocean in the evening of 20 December. It concentrated into a depression at 0300 UTC of 21 and lay centred near Lat. 4.0° N/ Long. 77.0° E. Moving initially in an easterly and later in a northeasterly direction, it intensified into a deep depression and lay centred near Lat. 5.0° N/ Long. 81.0° E at 1800 UTC of 23. Continuing its northeasterly movement, it intensified into a cyclonic storm and lay centred near Lat. 5.5° N/ Long. 81.5° E at 0300 UTC of 24. It further moved in a northeasterly direction and weakened into a deep depression at 0300 UTC of 25 and lay centred near Lat. 7.0° N / Long. 83.5° E. Subsequently, moving in an eastnortheasterly direction, it weakened into a depression at 1200 UTC of 25 and lay centred near Lat. 7.5° N / Long. 86.0° E. It further weakened into a low pressure area over southwest and adjoining southeast Bay after 1500 UTC of 25.

The maximum 'T' number was T 2.5 from 0300 to 1200 UTC of 24 as reported by METSAT (KALPANA I).

As the system dissipated over the ocean, it did not cause any damage.

3.3.2. *Weather and associated synoptic features*

Table 4 gives the details of synoptic features for the month of December 2002.

Very heavy rain occurred on1 day in Tamil Nadu.

3.3.3. *Monthly rainfall*

Monthly rainfall was *excess* in 4, *normal* in 1, *deficient* in 8 and *scanty* in 18 meteorological sub-divisions. There was no rain in the remaining 5 meteorological sub-divisions. It was *excess* in west Uttar Pradesh, Haryana, west Rajasthan and east Rajasthan; *normal* in Arunachal Pradesh; *deficient* in Andaman & Nicobar Islands, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Bihar, east Uttar Pradesh, Saurashtra & Kutch and Tamil Nadu; *scanty* in Gangetic West Bengal, Orissa, Jharkhand, Uttaranchal, Punjab, Himachal Pradesh, Jammu & Kashmir, west Madhya Pradesh, east Madhya Pradesh, Gujarat region, Konkan & Goa, Chattisgarh, coastal Andhra Pradesh, Rayalaseema, coastal Karnataka, south interior Karnataka, Kerala and Lakshadweep and there was no rain in Madhya Maharashtra, Marathwada, Vidarbha, Telangana and north interior Karnataka. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.3.4. *Temperature*

Night temperatures were generally *appreciably to markedly below normal* on 4 to 9 days in some parts of Jharkhand, Gujarat region, Rayalaseema, Tamil Nadu and Coastal Karnataka and on 1 to 3 days in Orissa, Bihar, Haryana, Punjab, Jammu & Kashmir, west Rajasthan, east Rajasthan, Konkan & Goa, Marathwada, Vidarbha, coastal Andhra Pradesh, north interior Karnataka, south interior Karnataka and Kerala. They were generally *appreciably to markedly above normal* over north, northwestern and central India throughout the month. They were *appreciably above normal* over most parts of northeastern states of India throughout the month.

Month's and season's lowest minimum temperatures in the plains of the country was 1.4° C recorded at Sarsawa (west Uttar Pradesh) on 29 December 2002.

3.3.5. *Disastrous weather events*

According to press reports, the persistent below normal temperatures took a toll of 98 people (77 in Uttar Pradesh, 18 in Bihar and 3 in Rajasthan) during the month.

Appendix

Definitions of the terms given in '*Italics*'

Rainfall

Excess - percentage departure from normal rainfall is + 20% or more.

Normal - percentage departure from normal rainfall is from –19 % to + 19 %.

Deficient - percentage departure from normal rainfall is from –20 % to –59 %.

Scanty - percentage departure from normal rainfall 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.

Monsoon activity

(a) Southwest monsoon

Vigorous - rainfall more than 4 times the normal with minimum 8 cm along the west coast and 5 cm elsewhere in atleast two stations in the sub-division. Rainfall in that sub-division should be fairly widespread or widespread.

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

(b) Northeast monsoon

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

Active - rainfall 1 ½ to 4 times the normal, with atleast two stations reporting 3 cm or more in coastal Tamil Nadu and south coastal Andhra Pradesh and 2 cm elsewhere. Rainfall in that sub-division should be fairly widespread or widespread.

Temperatures

Heat wave - departure of maximum temperature from normal is between + 4° C to + 5° C or more for the regions where the normal maximum temperature is more than 40° C and departure of maximum temperature from normal is +5° to + 6° C for the regions where the normal maximum temperature is 40° C or less. Declared only when the maximum temperature of a station reaches atleast 40° C for plains and atleast 35° C for Hilly regions.

Markedly above normal - departure of temperature from normal is between +5° C to +6° C for the regions where the normal maximum temperature is 40° C or less.

Appreciably above normal - departure of temperature from normal is between +3° C to +4° C for the regions where the normal maximum temperature is 40° C or less.

Appreciably below normal - departure of temperature from normal is between –3° C to –4° C.

Markedly below normal - departure of temperature from normal is –5° C or less.

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

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

Below normal - departure from normal temperature is –2° C.