MAUSAM, 48, 4 (October 1997), 679-690

Weather in India

Post-Monsoon Season (October-December 1996)*

1. Introduction

During the post-monsoon season 1996, two cyclones (5-7 November and 28 November-7 December), one deep depression (27-29 October) and one depression (1-2 October) formed over the Bay of Bengal. There was one severe cyclonic storm (22-27 October) over the Arabian Sea. The tracks of these systems are shown in Fig. 1.

The southwest monsoon withdrew from parts of west Rajasthan by 15 September and from the entire country by 11 October and simultaneously northeast monsoon rainfall commenced over Tamil Nadu and adjoining parts of Andhra Pradesh, Karnataka and Kerala. Monthly and seasonal rainfall amounts and their percentage departures are given in Table 1.

2. Chief features

(*i*) There were five intense cyclonic disturbances over north Indian Ocean, out of which, three attained the intensity of cyclones; one over the Arabian Sea and other two over the Bay of Bengal and two intensified into depressions over the Bay of Bengal.

(*ii*) Northeast monsoon rains commenced on 11 October over Tamil Nadu and adjoining parts of Andhra Pradesh, Karnataka and Kerala.

(*iii*) Heavy rains, during October, caused floods and damages in many districts of Andhra Pradesh and Karnataka. The severe cyclonic storm with a core of hurricane winds (5-7 November) caused extensive damage to property and life in coastal districts of Andhra Pradesh.

(*iv*) Cold wave conditions prevailed over Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir, Rajasthan and West Madhya Pradesh on some days in December.

3. Season's rainfall

Season's rainfall was excess in 11, normal in 15, deficient in 6 and scanty in 3 meteorological sub-divisions. Rainfall was excess in Assam & Meghalaya, east Uttar Pradesh, Gujarat State, Konkan & Goa, Madhya Maharashtra, Andhra Pradesh, Tamil Nadu and north interior Karnataka; normal in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, Bihar Plains, plains of west Uttar Pradesh, Haryana, Rajasthan, west Madhya Pradesh, Marathwada, Vidarbha, coastal & south interior Karnataka, Kerala and Lakshadweep; deficient in West Bengal & Sikkim, Punjab, Himachal Pradesh, Jammu & Kashmir, east Madhya Pradesh and scanty in Orissa, Bihar Plateau and Hills of west Uttar Pradesh. Seasonal rainfall departures are given in Fig. 2.

4. Monthly features

4.1. *October*

4.1.1. *Withdrawal of southwest monsoon*

The southwest monsoon withdrew from parts of west Rajasthan on 15 September and from east Rajasthan and rest of northwest India by 21 September. Monsoon further withdrew from Gujarat State, west Madhya Pradesh and west Uttar Pradesh and from some parts of Madhya Maharashtra on 24 September. Further withdrawal of the southwest monsoon was rather slow. By 8 October, it withdrew from Maharashtra, Madhya Pradesh, parts of Orissa, Uttar Pradesh, Bihar and West Bengal & Sikkim and from the entire country on 11 October, about a week earlier than the normal date.

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TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (October-December 1996)

S. No.	Meteorological sub-division	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	324	320	1	308	253	22	197	171	16	830	744	12
2.	Arunachal Pradesh	158	129	23	9	22	–61	1	14	–96	168	165	1
3.	Assam & Meghalaya	243	161	51	4	26	–84	0	13	–100	247	200	24
4.	Nag.,Mani.,Miz. & Tripura	162	149	9	12	42	–71	1	10	–87	175	201	–13
5.	SHWB & Sikkim	79	147	–46	1	16	–95	0	5	–99	80	168	–53
6.	Gangetic West Bengal	103	120	–14	3	19	–86	0	3	–99	106	142	–26
7.	Orissa	53	120	–56	8	29	–74	0	6	–95	61	156	–61
8.	Bihar Plateau	27	84	–67	1	12	–96	0	5	–100	28	101	–72
9.	Bihar Plains	73	64	14	0	8	–100	0	3	–100	73	76	–3
10.	East U.P.	99	48	106	0	5	–100	0	6	–100	99	59	69
11.	Plains of west U.P.	38	34	12	0	4	–100	0	9	–100	38	47	–18
12.	Hills of west U.P.	35	59	–40	0	8	–100	0	25	–100	35	93	–62
13.	Haryana,Chandi. & Delhi	24	18	32	**	4	–99	0	8	–98	24	30	–19
14.	Punjab	24	21	11	0	4	–100	1	15	–94	25	40	–39
15.	Himachal Pradesh	35	43	–17	0	13	–100	5	36	–87	40	92	–57
16.	Jammu & Kashmir	38	29	33	6	17	–67	5	48	–90	49	94	–48
17.	West Rajasthan	9	5	81	0	2	–99	0	2	–95	9	9	2
18.	East Rajasthan	20	14	44	0	4	–97	0	4	–100	20	22	–8
19.	West Madhya Pradesh	59	31	89	2	16	–88	0	7	–100	61	54	13
20.	East Madhya Pradesh	30	52	–42	11	9	15	0	9	–100	41	70	–41
21.	Gujarat Region	50	27	88	0	9	–98	0	1	–100	50	37	36
22.	Saurashtra & Kutch	41	15	169	1	10	–91	0	1	–100	42	26	61
23.	Konkan & Goa	212	113	88	3	28	–91	0	7	–94	215	148	45
24.	Madhya Maharashtra	178	72	148	7	29	–76	1	7	–85	186	108	72
25.	Marathwada	100	59	69	3	20	–87	2	8	–81	105	88	19
26.	Vidarbha	88	51	73	4	17	–78	0	10	–100	92	77	19
27.	Coastal A.P.	284	190	49	83	99	–16	43	23	88	410	313	31
28.	Telangana	114	78	47	22	20	13	0	8	–100	136	105	30
29.	Rayalaseema	257	114	125	31	73	–57	108	26	310	396	213	86
30.	Tamil Nadu & Pondy.	193	196	–1	131	192	–32	271	89	204	595	477	25
31.	Coastal Karnataka	233	184	27	21	66	–68	47	14	227	301	264	14
32.	N.I. Karnataka	175	93	88	8	27	–69	5	7	–36	188	127	48
33.	S.I. Karnataka	155	149	3	11	53	–78	42	15	190	208	217	–4
34.	Kerala	319	288	11	97	164	–41	88	42	108	505	495	2
35.	Lakshadweep	109	138	–21	60	118	–49	132	69	90	301	326	–8

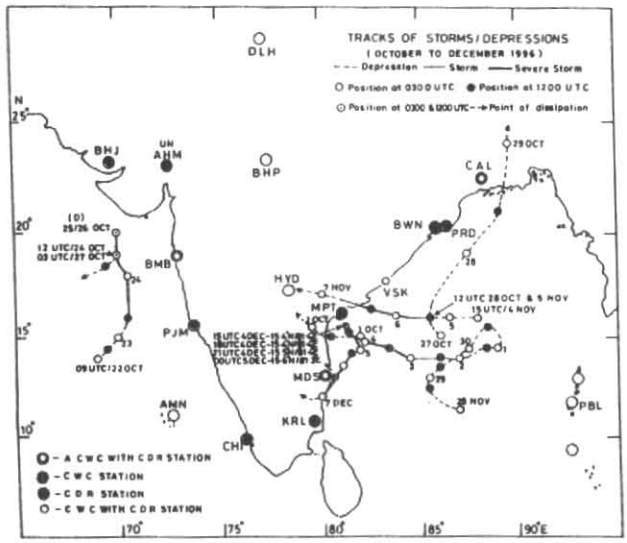

Fig. 1. Tracks of storms/depressions during the period October-December 1996

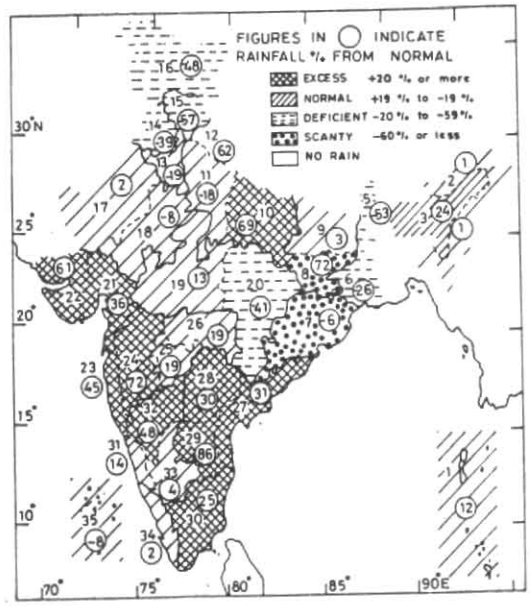

Fig. 2. Seasonal rainfall departure (%) for the period October- December 1996

4.1.2. *Onset of northeast monsoon*

The northeast monsoon rains commenced over Tamil Nadu and adjoining parts of Andhra Pradesh, Karnataka and Kerala on 11 October 1996.

4.1.3. *Storms/depressions*

(a) *Arabian Sea* - A severe cyclonic storm (22-27 October) formed as a depression over east-central Arabian Sea on the afternoon of 22nd and moved northwards initially. It intensified into a cyclonic storm on 23rd afternoon and later into a severe cyclonic storm and then moved in a north-northwesterly to northerly direction upto 25th October. Later, it moved in a southerly direction and weakened into a well-marked low pressure area by morning of 28 over the west-central Arabian Sea area.

(b) *Bay of Bengal* - A depression (1-2 October) formed over west-central Bay off Andhra coast on 1st October. Moving in a westerly direction, it crossed south Andhra coast on the midnight of 1st and dissipated over Rayalaseema and adjoining north interior Karnataka on 2nd. A deep depression (27-29 October) formed over east-central Bay on 27th morning. It moved in a north-northeasterly direction and crossed West Bengal-Bangladesh coast on 29th and weakened into a well-marked low pressure area over north Bangladesh and adjoining Meghalaya.

4.1.4. *Weather and associated synoptic features*

Table 2 gives the details of these and other synoptic features for the month of October 1996. Southwest/ northeast monsoon was vigorous on 4 to 6 days in coastal Andhra Pradesh, Rayalaseema and north interior Karnataka and on 1 to 3 days in Bihar plains, east Uttar Pradesh, west Madhya Pradesh, Gujarat Region, Konkan & Goa, Madhya Maharashtra, Marathwada and coastal & south interior Karnataka. It was active on 5 to 7 days in coastal Karnataka and Kerala and on 1 to 3 days in Sub-Himalayan West Bengal & Sikkim, Bihar Plains, plains of Uttar Pradesh, Konkan & Goa, Marathwada, coastal Andhra Pradesh, Rayalaseema and south interior Karnataka. Rain or thundershowers have occurred either almost at all the places or at many places on 10 to 16 days in Andaman & Nicobar islands and Tamil Nadu; on 6 to 7 days in Kerala and Lakshadweep; on 2 to 5 days in West Bengal & Sikkim, Orissa, Punjab, Himachal Pradesh, Konkan & Goa, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, Telangana and coastal & south interior Karnataka and on one day each in Arunachal Pradesh and Haryana.

4.1.5. *Month's rainfall*

Monthly rainfall was excess in 19, normal in 10, deficient in 5 and scanty in only 1 meteorological sub-divisions during October 1996. Rainfall was excess in Arunachal Pradesh, Assam & Meghalaya, east Uttar Pradesh, Haryana, Jammu & Kashmir, Rajasthan, west Madhya Pradesh, Gujarat, Maharashtra & Goa states, Andhra Pradesh and coastal & north interior Karnataka; normal in Andaman & Nicobar Islands, Nagaland, Manipur, Mizoram & Tripura, Gangetic West Bengal, Bihar Plains, plains of west Uttar Pradesh, Punjab, Himachal Pradesh, Tamil Nadu, south interior Karnataka and Kerala; deficient in Sub-Himalayan, West Bengal & Sikkim, Orissa, hills of west Uttar Pradesh, east Madhya Pradesh and Lakshadweep and scanty in Bihar Plateau. The significant amounts of rainfall (cm) during the month are given in Table 5.

4.1.6. *Temperature*

Day temperatures were above or appreciably above normal from 11 to 26 October over Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura and West Bengal & Sikkim and Himachal Pradesh and from 10 to 20 October over west Rajasthan, Gujarat State, Konkan & Goa and coastal Karnataka. They were appreciably to markedly below normal on first and last weeks of the month over Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Punjab, Jammu & Kashmir, Rajasthan, Gujarat Region and Madhya Maharashtra. They were generally normal over the rest of the country.

Night temperatures were markedly below normal on 1 to 2 days in Bihar, Punjab and Madhya Maharashtra and were below to appreciably below normal on most of the days of the month over Nagaland, Manipur, Mizoram & Tripura and south interior Karnataka and on many days over Sub-Himalayan, West Bengal & Sikkim, Bihar, Punjab, Madhya Maharashtra and Marathwada. They were above to appreciably above normal in plains of west Uttar Pradesh, Rajasthan, Madhya Pradesh, Gujarat State, Marathwada, Vidarbha & Telangana in the last week of the month.

41°C was the highest day temperature, recorded over the plains by Bhuj on 15, 16, 17 and 18 October.

The lowest night temperature of 10°C over the plains was recorded at Amritsar (25 October) and 2°C over hills at Srinagar (24 to 26 and 29 October).

4.1.7. *Disastrous weather events and associated damages*

Northeast monsoon was vigorous (18-20 October) over coastal Andhra Pradesh and this caused disastrous weather over the state. During this period, 326 people lost their lives and properties and crops worth crores of rupees were damaged. Also, 7 persons in Sikkim, 4 in Maharashtra, 22 in Andhra Pradesh and 15 in Karnataka lost their lives due to torrential rains, floods and landslides on 2 October.

4.2. *November*

4.2.1. *Storms/depressions*

(a) *Arabian Sea* - No storms/depressions formed over the Arabian Sea.

(b) *Bay of Bengal* - A severe cyclonic storm with a core of hurricane winds (5-7 November) formed as a depression over east-central and adjoining west-central Bay on 4. Moving in a westerly direction and after attaining the intensity of a hurricane, it crossed Andhra Pradesh coast on 6 and weakened rapidly on 7. Another severe cyclonic storm with a core of hurricane winds (28 November-7 December) formed over southeast Bay on 28 November as a depression. It initially moved in a west-northwesterly direction and then, made first loop near 88°E on 1 December and second loop near 81°E, close to Andhra Pradesh coast on 5 October. It finally crossed north Tamil Nadu coast on the evening of 6 December and dissipated on 7 December. This system created a record in the history due to its unusual movement over the Bay of the Bengal.

Details of the system are given in Table 3.

4.2.2. *Weather and associated synoptic features*

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

Northeast monsoon was active on two days (22 and 24 November) over Rayalaseema. Rain or thundershowers occurred either almost at all the places or at many places on 15 days in Andaman & Nicobar Islands and on 1 to 4 days in Jammu & Kashmir, Konkan & Goa, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, Telangana, Tamil Nadu and Kerala. Mainly dry weather prevailed over Arunachal

TABLE 2

Details of the weather systems during October 1996

S. No.	System	Duration	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) *Storms and depressions*						
(1)	Depression	1-2	West-central Bay off north Andhra coast	Initially westerly, then westnorth-westerly and finally north-northwesterly	Southern parts of Uttar Pradesh	It crossed south Andhra coast near Ongole at midnight of 1st. It was first observed as a cyclonic circulaton (cycir) over the same area in the first week of September
(2)	Severe cyclonic storm	20 Oct-4 Nov	East-central Arabian Sea off south Maharashtra-Goa-Karnataka coast	Initially northeasterly, northerly and finally southwesterly	Somalia coast and adjoining Gulf of Aden	It was first observed as a cycir at mid-tropospheric levels on 20, became well marked low pressure area on 21, depression on 23, cyclonic storm on 24 and severe cyclonic storm on 24 afternoon. It weakened into a depression near 30 km southwest of Veraval, and moving in a westerly direction it headed towards Somalia coast
(3)	Deep depression	22-31	North Andaman Sea and neighbourhood	Initially north-northwesterly and then northeasterly	Bangladesh and adjoining Meghalaya	It was first observed as a low pressure area on 22, well marked on 25, depression on 27, deep depression on 28. It moved away northeastwards
(B) *Low pressure areas*						
(1)	Low pressure area	1-5	Gulf of Siam	Quasi-stationary	Northern parts of east-central Bay	Associated cycir extended upto mid-tropospheric levels
(2)	Do	7-8	Off Andhra coast	Stationary	*In situ*	Associated cycir extended upto 1.5 km asl. It was observed over west-central and adjoining southwest Bay off north Tamil Nadu coast on 8, over Kerala and adjoining Lakshadweep area on 12 and became less marked on 13
(3)	Well marked low pressure area	13-20	North Andaman Sea and neighbourhood	West-northwesterly	Rayalaseema and neighbourhood	Associated cycir extended upto mid-tropospheric levels. It tilted southwards with height on 19. The system became well marked on 16, it moved inland on 19 and lay as a low pressure area over Rayalaseema
(C) *Induced cyclonic circulations*						
(1)	Mid-tropospheric levels	13-14	Punjab and neighbourhood	Stationary	*In situ*	
(2)	Lower tropospheric levels	17-18	Northeast Pakistan and neighbourhood	Westerly	Northwest Rajasthan and neighbourhood	

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(D) *Other cyclonic circulations*						
(1)	Lower levels	8-9	North Bangladesh and neighbourhood	Stationary	*In situ*	
(2)	Do	11-14	West-central Bay off Andhra coast	Westerly	South Kerala and neighbourhood	Moved away westwards
(3)	Mid-tropospheric levels	15-16	Southwest Bay off north Tamil Nadu coast	Stationary	*In situ*	Merged with the associated cycir of well marked low pressure area (System No. B- 3). It was first observed as a trough in the lower levels on 14 over the same area
(4)	Lower tropospheric levels	15-20	North Lakshadweep area and neighbourhood	Do	Do	Merged with the well marked low pressure area (System No. B-3)
(5)	Mid-tropospheric levels	20-21	West-central Bay off Andhra coast	Do	Do	Merged with the seasonal trough
(6)	Upper tropospheric levels	25-26	North Rajasthan and neighbourhood	Do	Do	
(7)	Mid-tropospheric levels	26-27	North Andaman Sea and neighbourhood	Do	Do	
(E) *Troughs*						
(1)	Sea level chart	4-8	Gujarat coast to Kerala coast	Stationary	*In situ*	
(2)	Mid-tropospheric levels	6-8	Sub-Himalayan West Bengal to north Bay	Do	Do	
(3)	Sea level chart	10-14	Lakshadweep area and neighbourhood	Easterly	Kerala and adjoining Lakshadweep area	
(4)	Upper air	17-19	Off north Tamil Nadu coast to Nagaland, Manipur, Mizoram & Tripura through southeast Madhya Pradesh, Bihar Plateau and Bangladesh	Quasi-stationary	*In situ*	
(F) *Western disturbances*						
(1)	Upper air system	2-4	Punjab and adjoining parts of Rajasthan	Northeasterly	Moved away northeasterly across Jammu & Kashmir	
(2)	Do	5-6	North Pakistan and neighbourhood	Do	Do	
(3)	Do	12-14	Do	Do	Do	
(4)	Do	18-22	North Pakistan and adjoining Jammu & Kashmir	Do	Do	

Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Orissa, Bihar, Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Rajasthan, Madhya Pradesh, Gujarat State and Vidarbha.

4.2.3. *Month's rainfall*

Rainfall was excess in 1, normal in 3, deficient in 4 and scanty in 21 meteorological sub-divisions. There was no rain in 6 meteorological sub-divisions. Rainfall was excess in Andaman & Nicobar Islands; normal in east Madhya Pradesh, coastal Andhra Pradesh and Telangana; deficient in Rayalaseema, Tamil Nadu, Kerala and Lakshadweep and scanty over the rest of the counry outside Bihar Plains, Uttar Pradesh, Punjab and Himachal Pradesh where there was no rain.

4.2.4. *Temperature*

Cold wave conditions prevailed on 2 to 5 days in Punjab, west Rajasthan and Kutch. Night temperatures were below to appreciably below normal over Saurashtra & Kutch, Madhya Maharashtra, Marathwada, Telangana, Rayalaseema, Tamil Nadu and interior Karnataka in the first week of the month; over Bihar Plateau, Rajasthan, west Madhya Pradesh, Gujarat State, Madhya Maharashtra and Marathwada from 16 to 20 November and over Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Bihar, Haryana, Punjab, Jammu, west Rajasthan, Madhya Maharashtra and south interior Karnataka in the last week of the month. They were appreciably to markedly above normal on few days in Nagaland, Manipur, Mizoram & Tripura, Orissa, Rajasthan, Madhya Pradesh, Gujarat region, Marathwada, Vidarbha, coastal Andhra Pradesh and Telangana and were generally normal over the rest of the country.

1°C was the minimum temperature over plains recorded by Amritsar on 29 November and – 3°C was the minimum temperature recorded over hills by Srinagar on 16 November.

4.2.5. *Disastrous weather events and associated damages*

A severe cyclonic storm with a core of hurricane winds (5-7 November) caused extensive damage and took a toll of about 1058 human lives in coastal Andhra Pradesh. Also more than 1677 fishermen were missing and 6800 fishing boats were damaged or lost in the state.

4.3. *December*

4.3.1. *Storms/depressions*

(a) *Arabian Sea* - No storm or depression formed in the Arabian Sea.

(b) *Bay of Bengal* - A severe cyclonic storm with a core of hurricane winds (28 November-7 December) which formed over southeast Bay as a depression on 28 November and continued in the first week of December. After the unusual movement as described earlier, it crossed north Tamil Nadu coast on the evening of 6 December and dissipated on 7 December. Details of the system are given in Table 4.

4.3.2. *Weather and associated synoptic features*

Two western disturbances over Pakistan and neighbourhood, two low pressure areas; one over southwest Bay and other over southeast Bay and neighbourhood, one induced cyclonic circulation over Punjab and neighbourhood; two troughs over southwest Bay and two cyclonic circulations; one over the Andaman Sea and neighbourhood and other over southwest Bay off north Tamil Nadu coast were observed during the month. Details of synoptic features for the month of December are given in Table 4.

Northeast monsoon was vigorous on 5 days in Rayalaseema and on 2 to 3 days in south interior Karnataka and Kerala. It was active on one day in coastal Karnataka during December. Rain or thundershowers occurred either almost at all the places or at many places for 9 to 11 days in Andaman & Nicobar Islands and Tamil Nadu and on 1 to 2 days in Jammu & Kashmir, coastal Karnataka and Lakshadweep. Mainly dry weather prevailed over the rest of the country.

4.3.3. *Month's rainfall*

The month's rainfall was excess in 7, normal in 1, deficient in 1 and scanty in 13 meteorological sub-divisions. The rest of the meteorological sub-divisions (13) did not record any rainfall during the month. The rainfall was excess in coastal Andhra Pradesh, Rayalaseema, Tamil Nadu, coastal & south interior Karnataka, Kerala and Lakshadweep; normal in Andaman & Nicobar Islands; deficient in north

TABLE 3

Details of the weather systems during November 1996

S. No.	System	Duration	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) *Storms and depressions*						
(1)	Severe cyclonic storm with a core of hurricane winds	30 Oct-10 Nov	North Andaman Sea off Tenasserim coast	Initially westerly, then westnorth-westerly	South Gujarat Region and adjoining south Saurashtra	It was first observed as a low pressure area on 30 Oct., became well marked on 4 Nov. It was concentrated into a deep depression on 4 evening. On, 5 evening it intensified into a cyclonic storm, became severe cyclonic storm on 6 morning and severe cyclonic storm with a core of hurricane winds on the same afternoon. It rapidly weakened into a deep depression close to Rentachintala
(2)	Severe cyclonic storm with a core of hurricane winds	27 Nov-6 Dec	Southeast Bay and neighbourhood	Made first loop near 14°/88° E and another loop close to Andhra Pradesh coast and finally moved in a south-westerly directon	Southeast Arabian Sea and adjoining Kerala and Lakshadweep region	The system concentrated into a depression on 28, deep depression on 29 Nov. cyclonic storm on 2 Dec., severe cyclonic storm on 3 and severe cyclonic storm with a core of hurricane winds on 4. It crossed Tamil Nadu coast between Chennai and Pondicherry between 2030 and 2230 hrs IST on 6. It became cyclonic storm on 7 morning and on 7 evening it lay as a well marked low pressure area near Salem. It weakened into a low pressure area on 8 over Kerala and adjoining Lakshadweep area
(B) *Low pressure areas*						
(1)	Low pressure area	19-24	Central Andaman Sea and adjoining southeast Bay	Northwesterly	Sri Lanka and adjoining Tamil Nadu coast	Associated cycir extended upto 1.5 km asl
(2)	Do	27 Nov-3 Dec	South Kerala and neighbourhood	Stationary	*In situ*	A trough from this system to Karnataka coast was observed from 28 Nov to 1 Dec
(C) *Induced cyclonic circulation*						
(1)	Lower levels	18-22	North Rajasthan and neighbourhood	Northeasterly	Haryana and adjoining parts of west Uttar Pradesh	
(D) *Other cyclonic circulations*						
(1)	Lower tropospheric levels	1-4	South Tamil Nadu and neighbourhood	Stationary	*In situ*	
(2)	Lower levels	2-3	Punjab and neighbourhood	Do	Do	
(3)	Mid-tropospheric levels	3-4	Central Andaman Sea	Do	Do	
(4)	Upper tropospheric levels	6-7	Lakshadweep area and neighbourhood	Do	Do	

TABLE 3 (*Contd*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(5)	Lower levels	11-13	Kerala and adjoining Tamil Nadu	Do	Do	
(6)	Upper tropospheric levels	12-14	West Rajasthan and neighbourhood	Northeasterly	Haryana and neighbourhood	
(6)	Do	12-13	West Assam and neighbourhood	Stationary	*In situ*	
(7)	Upper tropospheric levels	12-13	Jammu & Kashmir and adjoining north Pakistan	Northeasterly	Moved away northeastwards	
(8)	Mid-tropospheric levels	24-28	Sri Lanka and adjoining Tamil Nadu	Quasi-stationary	Tamil Nadu and neighbourhood	
(9)	Do	24	Karnataka coast and neighbourhood	Stationary	*In situ*	Less marked in the same evening
(10)	Do	24-25	South Andaman Sea and neighbourhood	Do	*In situ*	
(11)	(Feeble) Lower levels	26-27	Sub-Himalayan West Bengal and neighbourhood	Do	Do	
(12)	Mid-tropospheric levels	26-27	South Andaman Sea	Westerly	Southeast Andaman Sea and neighbourhood	
(E) *Troughs of low*						
(1)	Lower levels	13-14	North Andaman Sea to tamil Nadu-Sri Lanka coast	*Stationary*	*In situ*	With an embedded cycir over north Andaman Sea and neighbourhood on 13, it get less marked off north Tamil Nadu-south Andhra coast on 19
(2)	Lower levels (in the easterlies)	14-27	Off west coast to Lakshadweep area	Quasi-stationary	Off Karnataka coast to Lakshadweep area	
(3)	Lower levels	20-24	North Andaman Sea and adjoining Tenasserim coast	West-northwesterly	South Bay and adjoining south Andaman Sea	
(4)	Lower tropospheric levels	24-25	Arunachal Pradesh and neighbourhood	Stationary	*In situ*	
(5)	lower levels	25-26	Nagaland, Manipur, Mizoram and Tripura and neighbourhood			
(E) *Other trough*						
(1)	Lower tropospheric levels	8-9	Vidarbha to south interior Karnataka	Stationary	*In situ*	
(F) *Western disturbances*						
(1)	Upper air system	14-15	Central Pakistan and neighbourhood	Northeasterly	Moved away northeasterly across Jammu & Kashmir	
(2)	Do	18-22	North Pakistan and adjoining Jammu & Kashmir	East-northeasterly	Do	

TABLE 4

Details of the weather systems during December 1996

S. No.	System	Duration	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) *Low pressure areas*						
(1)	Well marked low pressure area	9-24	Southwest Bay and adjoining southeast Bay	Westerly	West-central Arabian Sea	Associated cycir extended upto lower tropospheric levels. A trough from this system to Maharashtra coast in lower levels was seen on 17. It became less marked on 19
(2)	Low pressure area	11-12	Southeast Bay and neighbourhood	Stationary	*In situ*	Merged with the above low pressure area
(B) *Western disturbances*						
(1)	Upper air system	7-8	Punjab and adjoining Pakistan	Northeasterly	Moved away north-eastwards across Jammu and Kashmir	
(2)	Do	25-29	Pakistan and neighbourhood	Do	Do	
(C) *Induced cyclonic circulations*						
(1)	Lower levels	25-27	Punjab and neighbourhood	Northeasterly	Haryana and neighbourhood	
(D) *Other cyclonic circulations*						
(1)	Lower tropospheric levels	16-20	Andaman Sea and neighbourhood	Stationary	*In situ*	
(2)	Do	17-19	Southwest Bay off north Tamil Nadu coast	Do	Do	
(E) *Troughs*						
(1)	Lower levels	27-29	Southwest Bay off Tamil Nadu coast	Stationary	*In situ*	
(2)	Do	31 Dec-3 Jan	Southwest Bay and neighbourhood	Do	Do	

interior Karnataka and scanty over the rest of the country outside Assam & Meghalaya, Bihar, Uttar Pradesh, east Rajasthan, Madhya Pradesh, Gujarat State, Vidarbha & Telangana where there was no rain.

4.3.4. *Temperature*

Severe cold wave conditions prevailed on 3-4 days over Punjab and Jammu and on 1 day each over Haryana, Rajasthan and west Madhya Pradesh. Cold wave conditions prevailed on many days (15-16 days) over Punjab and Kashmir, 5-7 days over Haryana, Jammu and west Rajasthan and on 2-4 days over Himachal Pradesh, east Rajasthan and west Madhya Pradesh. Night temperatures were appreciably to markedly below normal in the first week of the month in Sub-Himalayan, West Bengal & Sikkim, east Uttar Pradesh, Haryana, Konkan & Goa, Madhya Maharashtra, Marathwada, Telangana, Rayalaseema, Tamil Nadu and Karnataka and in the 2nd and 3rd week of the month West Bengal & Sikkim, Orissa, Bihar, Plains of Uttar Pradesh, west Madhya Pradesh, Gujarat Region, Madhya Maharashtra and Marathwada. They were appreciably to markedly above normal in

TABLE 5

Principal amounts of rainfall (> 2 cm)

Date	October	November	December
(1)	(2)	(3)	(4)
1.	Jammalamadugu 13, Nizamabad 17, Koyna Navaja 10, Ellamanchalli, Bandipura & Port Blair 9 each, Riachur 7	Puttur 8, Charmapuram 6, Kannur 5	Nil
2.	Kaveli 15, Kundukur 14, Allaggada & Panambur 13 each, Gangtok 12, Kolhapur & Kasargode 11 each, Hukkeri & Koyna 10 each	Gobichettipalayam 5, Port Blair 3	Car Nicobar 3
3.	Gangtok 20, Khed 18, Patan 16, Agartala, Tuni & Mani 11 each, Bailhougal 7, Beki Mathanguri & Vayithiry 5 each, Chanderi 4, Passighat, Canning Town, Srinagar, Nalgonda & Siralkoppa 3 each	Kondul 6, Hut Bay 4, Thathiengarpet 4, Tiruthuraipoondi 3 each	Port Blair 3
4.	Mahabaleshwar 28, Bhira 18, Datia 17, Sultanpur 9, Jhansi 8, Sevoke 7, Honavar 6, Paradip, Dehra Dun, Patiala & Chowari 5 each Long Island, Sriganganagar, Pendra, Osmanabad & Kozhikode 3 each	Nancowry 8	Nil
5.	Nilokheri 29, Kakrahi 20, Aniraghat 11, Bhira 10, Satara 9, Dharamsala 7, Kondul, Dabri, Nangal Dam & Jaipur 5 each, Chapra & Jashpurnagar 4 each, Banbasa & Bhainsdehi 3 each	Piravom 3	Hut Bay & Narsapur 3 each
6.	Sandheads 31, Bihubar 7, Passighat, Agartala 6 each, Gangtok 5, Hut Bay, Paradip & Regoli 3 each	Canning Town 3	Kondul 4,
7.	Passighat 10, Kherunighat 6, Car Nicobar 3	Peddapuram 27, Kakinada 22, Khammam 5, Usilampatti 3	Nancowry & Thiruvallur 13 each, Kancheepuram 11, Kaveli 8, Tirupathi 3
8.	Senkottah, Nancowry, Miao, Siliguri & Kanakpura 4 each	Bhimavaram 10, Hyderabad 6	Rapur 14, Hut Bay & Chennai 6 each, Gundalapet 3
9.	Aruppukottai 14, Gangtok 5, Kochi 3	Sulurpet 7, Sholapur 3	Chidambaram & Sirkali 18 each, Basaralu & Bettadap 8 each, Kozhikode 3
10.	Punalur 10, Pamban & Minicoy 5 each, Ongole 3	Nil	Vedaranyam 25, Muthupet 20, Car Nicobar 3
11.	Mayiladuthurai 9, Gangtok, Palakkad & Amini Divi 3 each	Nil	Villupuram 22, Tirupathi 17, Puttur & Sirkali 16 each, Port Blair 5
12.	Paramakudi 11, Kavali & Punalur 7 each	Ujjain, Nagpur & Vedaranyam 3 each	Cuddalore 6, Kochi 3
13.	Thiruvananthapuram 10, Kovilpatti 9, Punalur 8	Jagdalpur 3	Nellore 18, Cuddalore 12, Tirupathi 11, Car Nicobar 6
14.	Madikeri 14, Kochi 9, Pollachi 8, Maya Bandar 7, Cuddalore 3	Kunnamkulam 6	Kottumannarkoil 14, Tirupathi & Kochi 6 each
15.	Ottapidram 17, Thiruvananthapuram 6, Long Island 4	Nil	Kottumannarkoil 17, Thodupuzha 6, Tirupathi 5, Nancowry 3
16.	Tondi & Nilambur 11 each, Nancowry, Ongole & Honavar 3 each	Nil	Periyakulam 15, Munnar 13, Minicoy 5, Kolar Gold Fields 3
17.	Nellore & Irinjalakuda 10 each, Madras & Kanakpura 5 each, Mudibigere 4, Nandyal 3	Karaikal 5	Periyakulam 15
18.	Sulurpet 23, Chennai 17, Kollam 12, Rajampet 11	Chidambaram 14	Agumde 5

TABLE 5 (Contd.)

(1)	(2)	(3)	(4)
19.	Kundukur 29, Nandyal 13, Kanakapura 10, Chengannur 9, Kanakapura 7, Gadhinglaj 5, Hut Bay & Chennai 4 each	Port Balir 12	Kochi 6
20.	Bapatla & Anantpur 11 each, Karkala & Chitradurga 8 each, Bijapur 6, Car Nicobar 5, Banihal & Islampur 3 each	Maya Bandar 13	Nil
21.	Kankavli 9, Radhanagari & Eraniel 8 each, Narasapur & Koppal 6 each, Kondul & Chickmagalur 5 each, Bhuntar 3	Aryankavu 9, Chennai 7, Awantipur 6, Kondul 5	Nil
22.	Hut Bay & Ahmednagar 8 each, Khamgaon 6, Ambad 5, Rajpur & Kozhikode 4 each	Nellore 11, Cuddalore 7, Kondul 6, Punalur 3	Nil
23.	Dungerwadi 17, Hut Bay 12, Bhira 9, Ahmednagar 8, Paratwada 6, Machilipatnam 5, Kurnool 4, Raipur & Aurangabad 3 each	Karaikal 11, Kavali 7, Car Nicobar 5	Nil
24.	Nil	Karaikal 10, Kottayam 7, Nancowry 4	Nil
25.	Veraval 9	Nagapattinam 13	Nil
26.	Veraval 4, Maya Bandar 3	Vedaranyam 10, Car Nicobar 5, Manali 3, Minicoy 4, Kodungallur 3	Manali 3
27.	Agartala, Balasore & Indore 4 each, Nancowry, Veraval & Kalingapatnam 3 each	Vedaranniyam 8, Long Island 4	Nil
28.	Balasore 11, Calcutta 10, Port Blair 5	Nagapattinam 7, Adirampattinam 4, Maya Bandar 3	Nil
29.	Shillong 17, Canning Town 10, Agartala 7	Varkala 8,Nancowry 5	Nil
30.	North Lakhimpur 7	Maya Bandar 3	Nil
31.	Tirupattur 4, Imphal 3,	Nil	Nil

the 3rd week of the month over Saurashtra & Kutch, Maharashtra & Goa, coastal Andhra Pradesh and Telangana. They were generally normal over the rest of the country.

The lowest temperature recorded over plains was -1°C at Amritsar from 12 to 16 and -6° C over hills was recorded at Srinagar on 14, 16 & 23 December.

4.3.5. *Disastrous weather events and associated damages*

Thirty two persons lost their lives due to heavy rains and floods.