

Weather

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POST MONSOON SEASON (OCTOBER-DECEMBER 1991)*

1. Introduction

During the post monsoon season of 1991, three cyclonic disturbances formed over the Bay of Bengal. Out of these three, two depressions were in the month of October and one was a cyclonic storm in November (11-15). No system, however, developed in the Arabian Sea.

The southwest monsoon withdrew from the entire country by 18 October 1991. The northeast monsoon rainfall commenced over Kerala, Tamil Nadu and adjoining Karnataka and Andhra Pradesh on 20 October. Monthly and seasonal rainfall amounts and their percentage departures are given in Table 1.

2. Chief features

- (i) Formation of a cyclonic storm (11-15 November) and two depressions (12-14 October, 28-30 October) in the Bay of Bengal. The tracks of these systems are shown in Fig. 1.
- (ii) Withdrawal of SW monsoon from the country outside Tamil Nadu and Kerala by 18 October.
- (iii) Commencement of northeast monsoon rainfall over Tamil Nadu and Kerala on 20 October.
- (iv) Snowfall over Western Himalayas during last week of December.

3. Seasonal rainfall

Seasonal rainfall was excess in 5, normal in 8, deficient in 10 and scanty in 12 meteorological sub-divisions. Rainfall was excess in interior Karnataka, Rayalaseema, coastal Andhra Pradesh, Assam, Meghalaya & Nagaland, Manipur, Mizoram & Tripura. Seasonal rainfall departures are given in Fig. 2.

4. Monthly features

4.1. October

4.1.1. *Withdrawal of SW monsoon*—SW monsoon withdrew from NW India on 18 September. By 30 September, it withdrew from U.P., M.P., Gujarat and north Maharashtra. SW monsoon gradually withdrew from the entire country by 18 October.

4.1.2. *Onset of NE monsoon*—NE monsoon rainfall commenced over Tamil Nadu, Kerala and parts of Andhra Pradesh and Karnataka State on 20 October.

4.1.3. *Storms/Depressions*—A depression formed over NW Bay on 12 October and crossed the Bangladesh coast on 14 October and weakened thereafter. The second depression formed over southwest Bay on 28 October. It moved in a northwesterly direction and crossed the north Tamil Nadu coast near Cuddalore on 29 morning. It weakened into a well marked low on 30 October.

4.1.4. *Weather and associated synoptic features*—The details of synoptic features of the month are given in Table 3.

SW monsoon was active to vigorous on 4 to 6 days in Assam, Meghalaya, Nagaland, Manipur, Mizoram & Tripura and Gangetic West Bengal, on 2 to 3 days in Arunachal Pradesh, Madhya Maharashtra and interior Karnataka and on one day in Sub-Himalayan West Bengal & Sikkim. The number of days of active/vigorous NE monsoon during the month was 5 in Kerala, 4 in coastal Andhra Pradesh and 3 in Rayalaseema.

4.1.5. *Monthly rainfall*—Monthly rainfall was excess in 6, normal in 5, deficient in 7 and scanty in 11 meteorological sub-divisions. There was no rainfall in 6 meteorological sub-divisions. The significant amounts of rainfall (cm) during the month are given in Table 2.

4.1.6. *Temperature*—Day temperatures were above normal or appreciably above normal on most of the days during the month. The highest day temperature in the plains was recorded at Bhuj on 11 October when maximum temperature was 41°C which was 5°C above normal. The lowest day temperature of 23°C was recorded in plains at Tezpur on 14 and 15 October which was 7°C below normal.

— Cold wave conditions prevailed over hills of west Uttar Pradesh, Punjab and Jammu & Kashmir for 2 to 5 days in October.

Night temperatures were below normal or appreciably below normal in sub-Himalayan West Bengal & Sikkim, Bihar, Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Madhya Pradesh, Gujarat region, Saurashtra, Kutch and Maharashtra. They were generally normal over the rest of the country.

*Compiled by : U.S. De, D.S. Desai and C.S. Bais, Meteorological Office, Pune.

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TABLE 1

Sub-divisional means of rainfall (mm) for each month & season as a whole (October-December 1991)

Sub-divisions	October			November			December			Season		
	Actual	Normal	%	Actual	Normal	%	Actual	Normal	%	Actual	Normal	%
1. Bay Islands	284	319	-11	111	253	-56	69	171	-60	464	743	-38
2. Arunachal Pradesh	113	117	-4	1	21	-97	20	11	74	133	149	-11
3. Assam & Meghalaya	187	148	26	7	29	-74	19	11	67	213	188	13
4. Naga, Mani. & Mizo.	231	162	43	46	33	39	32	11	205	310	206	51
5. S.H.W.B. & Sikkim	61	146	-58	0	16	-99	32	5	587	94	167	-44
6. Gangetic West Bengal	89	122	-28	3	19	-83	66	3	1897	158	145	9
7. Orissa	100	118	-15	39	28	37	8	7	21	147	153	-4
8. Bihar Plateau	31	84	-63	0	11	-96	68	5	1404	99	99	0
9. Bihar Plains	6	63	-90	0	10	-96	9	3	264	16	75	-79
10. East Uttar Pradesh	0	48	-100	4	5	-15	13	7	92	17	59	-71
11. Plains of West U.P.	0	34	-100	7	4	76	15	9	64	22	47	-53
12. Hills of West U.P.	0	58	-100	10	11	-7	28	25	13	38	94	-60
13. Haryana, Chand. & Delhi	0	16	-98	3	3	0	29	9	211	33	29	13
14. Punjab	2	21	-89	0	4	-95	32	15	115	35	40	-14
15. Himachal Pradesh	2	42	-95	4	14	-69	52	39	34	58	95	-38
16. Jammu & Kashmir	7	36	-82	1	33	-98	7	75	-91	13	144	-91
17. West Rajasthan	0	6	-100	0	2	-95	1	3	-67	1	10	-90
18. East Rajasthan	0	15	-99	5	4	37	7	4	83	13	22	-43
19. West Madhya Pradesh	0	32	-99	8	15	-48	4	5	-19	12	52	-77
20. East Madhya Pradesh	23	51	-55	0	8	-95	18	11	65	42	71	-41
21. Gujarat Region	0	27	-100	1	9	-86	0	1	-100	1	37	-97
22. Saurashtra, Kutch & Diu	0	13	-100	0	5	-100	1	2	-65	1	20	-97
23. Konkan & Goa	21	113	-81	5	26	-80	2	9	-79	28	148	-81
24. Madhya Maharashtra	30	72	-59	5	30	-84	0	7	-99	34	109	-69
25. Marathwada	5	57	-91	10	19	-47	0	9	-100	15	85	-82
26. Vidarbha	9	43	-79	14	15	-2	1	15	-90	25	72	-66
27. Coastal A.P.	184	195	-6	211	102	107	6	23	-75	401	320	25
28. Telangana	32	77	-58	35	20	76	1	7	-93	68	103	-34
29. Rayalaseema	166	118	41	158	74	114	1	27	-97	325	219	49
30. Tamil Nadu	246	196	25	211	191	10	25	86	-71	487	473	3
31. Coastal Karnataka	103	184	-44	43	66	-36	2	15	-85	148	263	-44
32. N.I. Karnataka	55	93	-40	16	27	-42	0	8	-100	71	128	-44
33. S.I. Karnataka	235	153	53	81	57	41	0	13	-99	316	224	41
34. Kerala	291	293	-1	100	164	-39	3	43	-93	393	499	-21
35. Lakshadweep	221	163	36	75	102	-26	29	69	-59	326	334	-3

The lowest night temperature during the month in the plains was 10°C at Amritsar between 2 and 4 October which was 9 to 11°C below normal. In the hills, Srinagar recorded the lowest night temperature of 1°C on 30 October which was 3°C below normal.

4.1.7. Disastrous weather events and damages during October—The two depressions which developed during the month gave heavy rains in Assam, Tamil Nadu and Andhra Pradesh. The tributaries of *Brahmaputra*, viz., Dhansi, Jiabharali, Kopili and Puthimani flowed above their respective danger levels. According to reports most parts of Guwahati city were submerged in knee-deep water paralysing the normal life. Nearly 21 persons were feared killed in the worst ever land slide that demolished several dwelling houses in Kachari Barti area of Guwahati city.

The road communication between the upper and the lower Assam was disrupted following a break down of a Strice Gate near Kheti. 31 Persons lost their lives due to heavy rains and floods. The damage in the State of Assam on this account is summarised below :

1. No. of districts affected	5
2. Area affected in hectares	47,680
3. No. of villages affected	591
4. Population affected	5,94,249
5. Loss of human lives	18
6. Cattle lost	109

4.2. November

4.2.1. Storms/Depressions—A cyclonic storm (11-15) formed over the Bay of Bengal out of a remnant of the Pacific tropical storm (TS) THELMA. It concentrated into a depression over southeast Bay on 11 and further intensified into a cyclonic storm on 13. It crossed Tamil Nadu coast just north of Karaikal on 15 and weakened. The system gave heavy rainfall in Tamil Nadu, Andhra Pradesh and south interior Karnataka.

4.2.2. Weather and associated synoptic features—Four western disturbances over north Pakistan and one induced cyclonic circulation over northwest Rajasthan and adjoining Pakistan were observed during the month. A trough in the middle and upper tropospheric westerlies was seen along Long. 60° E north of Lat. 25°N between 26 and 30.

The details of the synoptic features of the month are given in Table 4. Northeast monsoon was active to vigorous on 1 and 2 November in coastal Andhra Pradesh and Rayalaseema and Kerala. It was also vigorous from 15 to 19 November in coastal Andhra Pradesh and Rayalaseema.

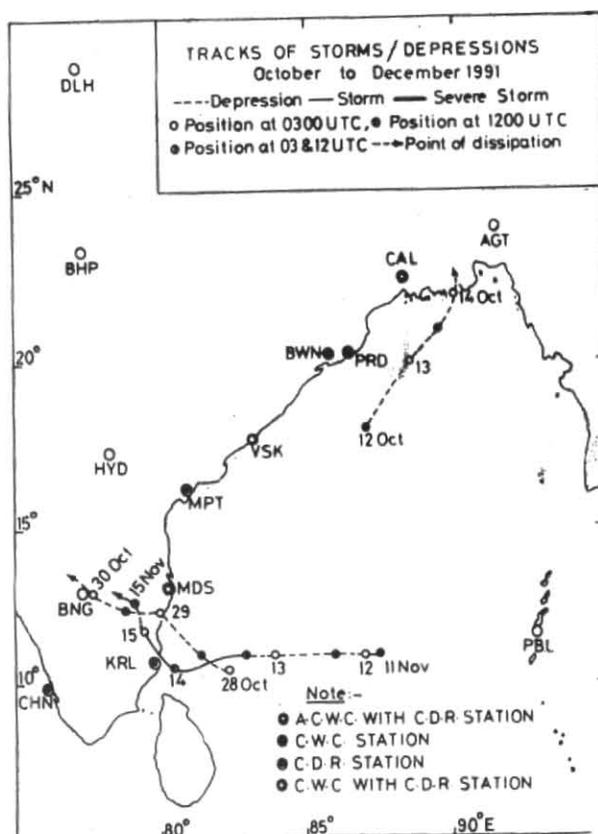


Fig. 1. Tracks of storms/depressions during October-December 1991

Rain or thundershowers occurred either almost at all the places or at many places on 3 to 5 days in Tamil Nadu, Andaman & Nicobar islands and south interior Karnataka and on 1 to 2 days in Nagaland, Manipur, Mizoram & Tripura, Orissa, plains of west Uttar Pradesh, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, coastal Karnataka and Telangana, Kerala and Lakshadweep. Mainly dry weather prevailed in Saurashtra, Kutch and Diu.

4.2.3. Month's rainfall—Rainfall was excess in 8, normal in 5, deficient in 7 and scanty in 14 meteorological sub-divisions. There was no rainfall in one meteorological sub-division.

Rainfall was excess in Nagaland, Manipur, Mizoram & Tripura, Orissa, hills of west Uttar Pradesh, east Rajasthan, Andhra Pradesh and south interior Karnataka. It was normal in east Uttar Pradesh, hills of west Uttar Pradesh, Haryana, Chandigarh and Delhi, Vidarbha and Tamil Nadu. It was either deficient or scanty in rest of the sub-divisions outside Saurashtra, Kutch and Diu where no rain occurred.

4.2.4. Temperature—Cold wave conditions prevailed over hills of west Uttar Pradesh, Himachal Pradesh and Jammu & Kashmir for 3 to 12 days. Night temperatures were either below or appreciably below normal in Assam

TABLE 2

Monthly rainfall amounts (cm)

Date	October 1991	November 1991	December 1991
1	Kannur 17, Udamalpet 12, Madurai 7, Belgaum 6, Kalimpong 5	Atmakar 11, Imphal 8, Agathi, Koderu & Silchar 6 each, Aizwal & Badvel 5 each	
2	Gadhinglaj 8, Harapanahalli 5, Karjat and Nidadavolu 4 each	Ponal Anaikal 15, Bhopalpatnam & Tirupathi 12 each, Puttur 9, Khanapur and Nizambad 8 each	Nancowry 4
3	Hosadurga 9, Aryankavu & Panagarh 8 each, Kumbakanam 7, Nagapattinam 6	Cheyar & Naraj 9 each, Guntur & Pakala 7 each, Gadchiroli & Jagdalpur 6 each	
4	Contai, Khowai & Rajghat 7 each, Alimattidam 6, Arundhutinagar & Baripada 4 each	Tenai 10, Bhubaneswar & Koderu 9 each, Madhira 5, Vijayavada 4	
5	Hosanagara 15, Golaghat 12, Kunapur 9, Chaparmukh & Rengali 7 each	Hallymysore 11, Udamalpet 9, Puttur 6, Cuddalore 5, Salem 4	
6	Agumbe 12, Visakhapatnam 11, Kanda-gaon & Peermade 10 each, Baghdogra & Jhumpura 9 each	Pamban 15, Neyyattinkara 7, Karkala 5, Palakkad & Sulya 4 each, Machilipatnam 3	
7	Haripad, Pondicherry & Salem 9 each, Terpur 8, Narainpur 7, Agartala 6	Periyankulam and Thiruvalla 7 each, Mini-coy & Nellore 6 each, Tondi 4	
8	Sankalam 13, Bhimavaram & Kuppam 6 each, Jalpaiguri, Mancherial, Machilipatnam 5 each	Kavali & Vendaranyam 6 each, Madras 4	
9	Chikballpur, Pantnagar, Pattambi & Polavaram 6 each, Badvel, Mysore & Tirupathi 5 each	Satyamangalam 14, Koderu & Kollam 8 each, Machilipatnam 6	
10	Vaniambadi 11, Pandavapura 10, Arkal-dugu & Vandavasi 9 each, Venkatagiri-kota 8	Punalur 7, Kothagiri 6, Darwha & Nagc-coil 5 each	
11	Phulbani & Port Blair 7 each, Jharsuguda 6, Chatrapatti, Dumka, Krishnagar & Udipi 5 each	Pirvom & Tutticorin 7 each, Mayabandar 6, Karkala & Maddur 5 each, Kochi 4	
12	Agartala 10, Naraj 5, Adoor, Angul & Arkalgudue 4 each	Chowai & Nancowry 4 each, Dhampur & Kangra 3 each	
13	Punalur 15, Baripada, Bokajan Arundhatinagar & Shillong 6 each	Port Blair 7, Karaikal 6 Tiruvallur 5	Car Nicobar 5
14	Cherrapunji 31, Shillong 24, Guwahati 12, Arundhatinagar & Manmadurai 10 each	Madras 20, Satyavedu & Salurpet 19 each, Tambaram 17, Karaikal & Tirupathi 8 each	
15	Guwahati & Shillong 16 each, Talguppa 8, Paramkudi 6, Karkala 4	Karaikal & Venkatgiri 48 each, Nagapattinam 29, Kodur 19, Vedaranyam 16, Chit-toor 15	Pamban 3
16	Passighat 22, Bhimuniapatnam 15, Krishnagiri 7, Hosanagar & Imphal 6 each	Yeracaud 33, Nellore 26, Kavali 24, Virudhachalam 15, Bangalore 11, Hoskote 10	Tondi 8, Vedaranyam 5
17	Kuzithurai 11, Mudigere 8, Coonoor 6, Tiravur 6, Bhira 5	Ongole 21, Usilampatti 18, Tambaram 11, Badvel & Madras 9 each, Bapatla 8	Kattumannarkoil 6, Kodaikanal 3
18	Lakkavalli 7, Venkatapuram 6, Bhivani 5	Natham 17, Rapur 13, Udayagiri 12, Vayitri 10, Tiruttani 9, Badvel & Ongole 7 each	Pamban 4
19	Kodarasal 7, Dibrugah 5, Tondi 4	Kodengallur 5, Ambasamudram & Kan-kavli 4 each, Hingna 3	
20	Itanagar 9, Udayagiri 7, Tuticorin 6, Chandgad & Dibrugah 5 each		
21	Kurithurai 10, Thuchalay 9, Nagarcoil 7, Nalgonda 4	Bobbili 6, Gulbarga 4	Ghula 6, Vedaranyam 4
22	Manmadurai 10, Ambasamudram & Kanyakumari 9 each, Madurai 6, Med-chal 5	Madnoor & Choldavaram 4 each, Billcli 3	Nagapattinam 13, Vedaranyam 5, Ludhiyana & Vina 4 each, Narwana & Shimla 3 each

TABLE 2 (Contd.)

Date	October 1991	November 1991	December 1991
23	Usilampatti 6, Somwarpet 4		
24	Santhankulam 10, Kondul 7, Kadur 5, Karaikal & Yelhanka 4 each	Nagapattinam 10, Karaikal 7, Tondi 4	Bhadarwah 7, Calcutta, Dehradun, Jagadhari & Sultanpur 5 each
25	Ayikudi 6, Kodaikanal, Kundapur & Tiruvar 4 each		Burdwan 9, Agartala & Panagarh 7 each Jamshedpur, Malda & Ranchi 6 each
26	Natham 5, Periyakulam 4	Parangipettai 7	Dumka 6, Bhing, Nurpur & Sriniketan each, Agartala & Jamshedpur 3 each
27	Manmadurai 11, Kavali 4	Tiruthuraipoodi 7	Usilampatti 7, Madurai 3
28	Kavali 11, Chittoor 9, Nagapattinam 8		Koderu 4
29	Parangipettai 27, Cuddalore & Paradip 22 each, Pondicherry 19, Popur 18	Kunnamkulam 9	Manmadurai 7, Agathi 5, Manali
30	Bangarpet & Naduvattam 21, Puttur 19, Chittoor 15, Bangalore 13		Vedaranyam 4
31	Penukonda 19, Hallymysore 18, Kavali 12, Anantpur & Sulurpet 11 each.		Telchar 3

& Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim, Bihar, Uttar Pradesh, Punjab, Himachal Pradesh, Jammu & Kashmir, coastal and south interior Karnataka. Night temperatures were nearly normal over the rest of the country.

The lowest night temperature of 4°C (departure -3°C) was recorded at Amritsar in plains on 28 and -3°C (departure -2°C) at Srinagar in hills on 21, 25 and 29 November.

4.2.5. *Disastrous weather events and damages during November*—The cyclonic storm caused heavy rains resulting in floods in Andhra Pradesh, Tamil Nadu and Karnataka States. About 233 persons lost their lives in Andhra Pradesh due to heavy rains and floods. Nearly 1,79,286 people were evacuated. About 24,599 houses were fully damaged while 72,603 houses were partially damaged. 7,253 heads of cattle and 4,500 poultry birds perished. Standing crops worth crores of rupees were damaged. In Karnataka about a lakh houses were fully or partially damaged. 1,100 heads of cattle perished. There was extensive damage to crops and public and private property. Thousands of people were evacuated to safer places. Nearly 185 persons lost their lives in Tamil Nadu. 3,56,115 families in 3,920 villages were rendered homeless. 1.75 lakhs people were shifted to safer places. About 2.5 lakhs of huts were partially damaged and 99,281 houses were fully damaged. Crops over 2.36 lakhs hectares were also damaged. There was breach in a number of irrigation tanks. Thousands of livestock were lost. The loss was estimated to be around rupees 350 crores.

4.3. December

4.3.1. *Storm and depression*—No storm or depression formed in the Bay of Bengal and Arabian Sea.

4.3.2. *Weather and associated synoptic features*—5 western disturbances over north Pakistan and neighbourhood and 4 induced cyclonic circulations over Punjab and Rajasthan were observed during the month. Troughs in the lower levels over Andaman sea, south-west Bay off Tamil Nadu coast were also located. The details of the synoptic features are given in Table 5.

Rain or thundershowers occurred either almost at all the places or at many places in 2 to 4 days in Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, West Bengal, Bihar plateau, west Uttar Pradesh, Punjab, Himachal Pradesh and Lakshadweep and on one day in Andaman & Nicobar islands, Bihar plains, east Uttar Pradesh and Haryana, Chandigarh and Delhi. Rain or snow occurred at one or two places in Kashmir on the last day of the season *i.e.*, on 31 December.

Mainly dry weather prevailed over Gujarat region, Marathwada and north interior Karnataka.

4.3.3. *Month's rainfall*—The month's rainfall was excess in 15, normal in 2, deficient in 1 and scanty in 14 meteorological sub-divisions. There was no rainfall in 3 sub-divisions. Rainfall was in excess northeast India, West Bengal & Sikkim, Orissa, Bihar, east Uttar Pradesh and plains of west Uttar Pradesh, Punjab, Himachal Pradesh, Haryana, Chandigarh and Delhi, east Rajasthan and east Madhya Pradesh; normal in hills of west Uttar Pradesh and west Madhya Pradesh and deficient in Lakshadweep. Rainfall was scanty over the rest of the country outside Gujarat region, Marathwada and north interior Karnataka where there was no rain. The significant amounts of rainfall (cm) during the month are given in Table 2.

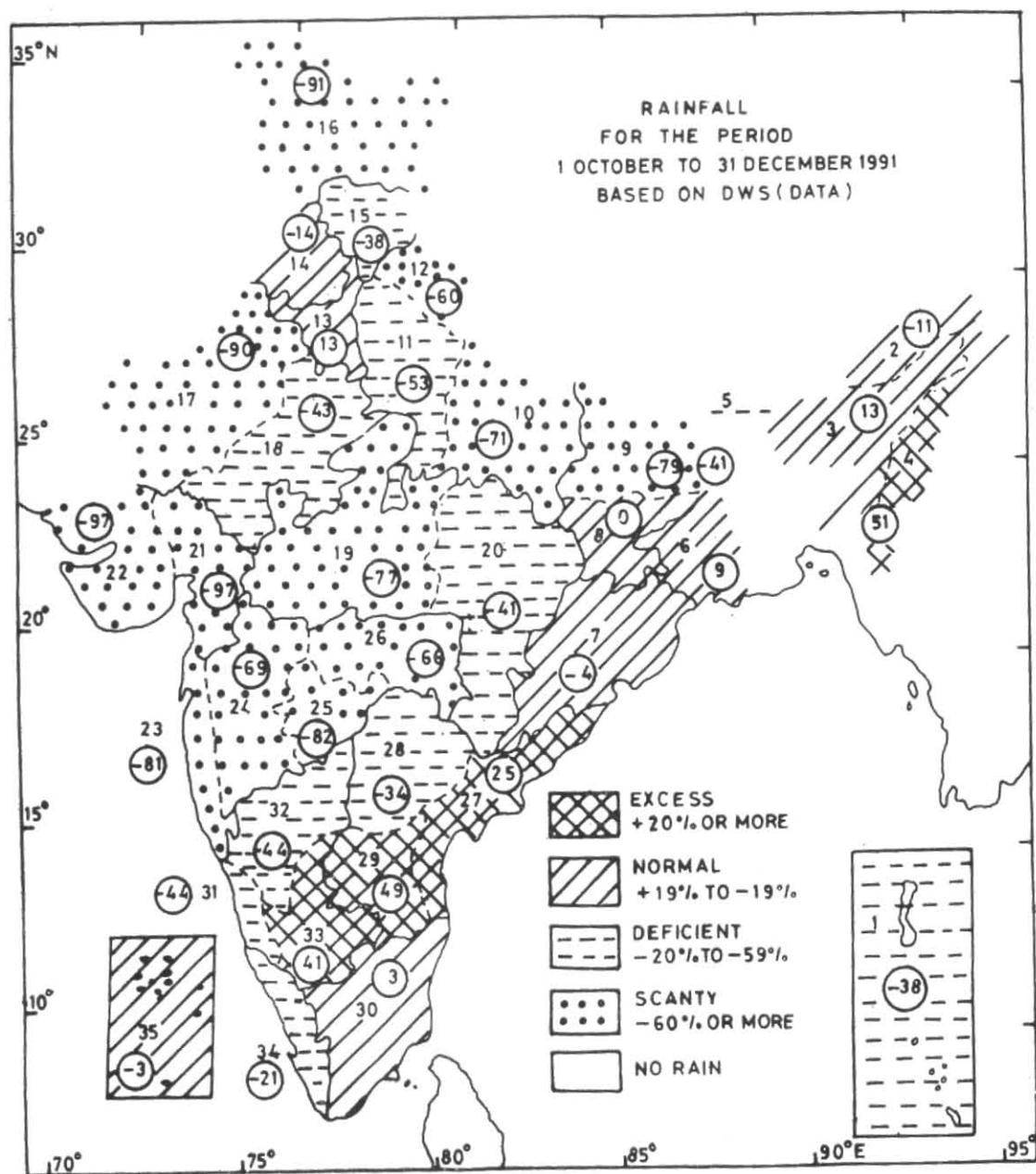


Fig. 2. Percentage departure from normal of rainfall for the period October-December 1991

TABLE 3
Details of weather systems during October 1991

Weather system	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(A) Depression					
(1) Depression	12-14	Lat. 20°N/Long. 88.5°E about 300 km south of Calcutta		N Bay weakened into a low pressure area on 15th; dissipated over Assam & Meghalaya and neighbourhood on 16th	It was observed as a CYCIR extending up to 4.5 km asl over WC Bay on 11th, a low pressure area on 12th
(2) Do.	28-30	350 km SSE of Madras (Lat. 10.5°N/Long. 82.5°E)	NW	Weakened to WM low pressure area on 31st. Associated cyclonic circulation became less marked over south Andhra Pradesh and neighbourhood on 5 Nov 1991	Observed as cyclonic circulation up to 1.5 km asl over N parts of S Bay on 24th. Low pressure area on 25th. Well marked low pressure area over S Bay adjoining WC Bay on 27th evening crossed evening Tamil Nadu coast near Cuddalore on 29 (morning)
(B) Cyclonic circulation					
(1) Up to mid-trop. level	1-10	S W Bay off south Andhra Pradesh—north Tamil Nadu coast		Vidarbha and neighbourhood	Observed between 1.5 and 5.8 km asl moved inland over north Tamil Nadu, south Andhra Pradesh 27th over Vidarbha
(2) Do.	13-17	Off north Kerala-south Karnataka coast	Stationary	<i>In situ</i>	—
(3) Lower and middle tropospheric level	23-28	Lakshadweep and neighbourhood		South Maharashtra coast and neighbourhood	
(C) Western disturbance					
(1) Upper air system	7-10	North Pakistan and neighbourhood		Moved to northern parts of Jammu & Kashmir and moved eastwards later	
(2) Do.	14-18	Pakistan and adjoining west Rajasthan	NE	Moved away eastwards across hills of west Uttar Pradesh	Traced as cyclonic circulation up to 2.1 km asl on 14 and developed low pressure area on 14 evening.
(3) Do.	21-24	North Pakistan and adjoining Punjab and Jammu & Kashmir	ENE	Moved across Himachal Pradesh and neighbourhood	
(4) Do.	27-30	North Pakistan and neighbourhood	E	Himachal Pradesh	Moved across Punjab and adjoining parts of Har-yana
(D) Trough in westerlies					
Middle and upper tropospheric level	14-17	Axis at 9.5 km asl along Long. 55°E north of 25°N	NEwards	Moved away along Long. 75°E north of Lat. 30°N	

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TABLE 4
Details of weather systems during November 1991

Weather system	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(A) Cyclonic storm					
(1) Cyclonic storm	11-19	SE Bay		It crossed Tamil Nadu coast between Nagapattinam and Cuddalore 03 GMT/15th, 50 km northwest of Cuddalore, DD-15E, D-16 M low pressure area, interior Karnataka and neighbourhood emerged into Arabian Sea, became less marked over southeast Arabian Sea off Goa-Karnataka coast on 19th	The remnant of Pacific storm 'THELMA' moved into Andaman sea across Tennassarim coast on 10th. It moved westwards and concentrated into depression on 12 linear Lat. 11°N/Long. 87°E, DD-SW Bay (13) 11.5°N/84°E C.S. 13 (12 GMT) 11.5°N/83°E
(2) Low pressure area	22-30	Comorin area and neighbourhood	West	SW Arabian Sea off north Somalia coast	It became well marked over Maldiva area adjoining southeast Arabian Sea on 23E, moved westwards and lay as low pressure area over southwest Arabian Sea and neighbourhood-26th E
(B) Cyclonic circulation					
(1) Lower level	2-5	EC Arabian Sea off Karnataka coast	Stationary	<i>In situ</i>	Observed up to 3.6 km asl
(2) Lower and middle level	5-7	WC Bay off Andhra Pradesh coast	Stationary	<i>In situ</i>	Observed on 5th up to 0.9 km asl and later extending up to middle tropospheric level on 6th
(C) Western disturbance					
(1) Upper air system	8-11	Central Afghanistan		Jammu & Kashmir	
(2) Do.	11-15	Russian Turkistan and adjoining north Afghanistan	Eastwards	Moved across Jammu & Kashmir	
(3) Do.	16-19	North Pakistan and adjoining Jammu & Kashmir	NE	Moved across Western Himalayas	
(4) Do.	26-28	North Pakistan and neighbourhood	NE	Moved across north-eastwards	
(D) Induced cyclonic circulation					
(1) Lower tropospheric	8-17	Northwest Rajasthan and adjoining Pakistan		Moved to west Uttar Pradesh persisted and became less marked on 17	
(E) Troughs					
(1) Lower level	19-26	SW Bay off Sri Lanka coast	Quasi-stationary	Kerala coast to south Maharashtra coast	
(2) Do.	21 Nov-1 Dec	Off Tamil Nadu coast			Seen as cyclonic circulation extending up to lower tropospheric levels over southwest Bay off south Tamil Nadu coast
(3) Middle and upper tropospheric westerlies	26-30	60°E North of 25°N		Moved away	

TABLE 5

Details of weather systems during December 1991

Weather system	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(A) <i>Induced low pressure area</i>	21-24	Northwest Rajasthan and adjoining Pakistan		Northeast Madhya Pradesh and adjoining parts of east Uttar Pradesh	Lay as cyclonic circulation on 22 extending up to 2.1 km asl over east Rajasthan and neighbourhood
(B) <i>Cyclonic circulation</i>					
(1) Upper air cyclonic circulation up to lower troposphere	24-26	Southeast Rajasthan and neighbourhood with trough extending southwards up to interior Karnataka			Observed as trough on northeast Madhya Pradesh and neighbourhood on 25 up to 1.5 km asl. A trough in lower level was running from Bihar plains to Telangana up to 28th
(C) <i>Western disturbance</i>					
(1) Upper air system	29 Nov-2 Dec	North Pakistan	Moved across Jammu & Kashmir		
(2) Do.	8-9	North Pakistan and neighbourhood	NEwards	Moved across Jammu & Kashmir	
(3) Do.	14-18	Do.	Do.	Do.	
(4) Do.	20-21	Do.	Eastwards	Do.	
(5) Do.	26-27	North Pakistan	NEwards	Moved across Western Himalayas	
(D) <i>Induced cyclonic circulation</i>					
(1) Lower levels	30 Nov-2 Dec	NW Rajasthan and neighbourhood	Moved across hills of west Uttar Pradesh		
(2) Do.	9-10	Punjab and adjoining parts of Pakistan	Stationary	<i>In situ</i>	
(3) Do.	27-1 Jan '92	Punjab and neighbourhood	Eastwards	Hills of west Uttar Pradesh	
(4) Between (1.5 & 2.1 km asl)	28-1 Jan '92	West Rajasthan and neighbourhood	SEwards	North Bay	Over coastal Orissa and neighbourhood on 1st morning

TABLE 5 (Contd.)

Weather system	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(E) Trough					
(1) Lower levels	2-4	North Andaman sea	Stationary	<i>In situ</i>	
(2) Do.	3-8	Off Tamil Nadu coast	Do.	<i>In situ</i>	
(3) Do.	10-15	SW Bay off Tamil Nadu coast		<i>In situ</i>	
(4) Do.	13-31	Andaman sea		South Kerala and neighbourhood	
(5) Trough of low	25-28	Southeast Bay	Quasi-stationary	Southeast Bay and adjoining parts of central Bay	If moved westwards to southwest Bay and merged with other trough on 16th
(6) Middle and upper tropospheric west-erlies	21-22	Axis at 9.5 km asi 66° E/32°N	NEwards		Moved westwards, lay over south Tamil Nadu coast and neighbourhood on 25th

4.3.4. *Temperature* — Cold wave conditions prevailed for a week over Sub-Himalayan West Bengal & Sikkim, hills of west Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir and west Rajasthan. Night temperatures were below to appreciably below normal on most of the days between 1 and 10 over the country outside Rajasthan, east Madhya Pradesh, Marathwada and Telangana where they were above normal. Night temperatures were generally above normal over the country outside northeast India, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, Telangana and interior Karnataka where they were below normal between 11 and 25. Night temperatures were below to appreciably below normal outside southern Peninsula during the last week of December. The lowest night temperature of 0°C (dep. -4°C) was recorded at

Amritsar on 31 in the plains and -5°C (dep. -4°C) at Srinagar on 2 and 3 December. The highest day temperatures of 36°C (dep. +2°C) was recorded at Surat on 3. The lowest day temperatures of 13°C (dep. -9°C) at Imphal and 4°C (dep. -3°C) at Srinagar were recorded in the plains and hills respectively.

4.3.5. *Disastrous weather events and damages during December* — Weather in association with cold wave claimed 22 lives in Rajasthan, Himachal Pradesh, Bihar, West Bengal and Jammu & Kashmir. 79 people were reported to have lost their lives in 3 different mishaps in West Bengal due to a country boat getting capsized down stream of the river *Ganges* as a result of heavy rains and strong winds.