MAUSAM, **53**, 4 (October 2002), 543-558

Weather in India

POST MONSOON SEASON (October-December 2001)*

1. Introduction

During the post-monsoon season of 2001, one cyclonic storm in the Arabian Sea (8-10 October), one cyclonic storm in the Bay of Bengal (14-17 October) and one depression over the Bay of Bengal (11 November) formed. Track of the storms and depression are shown in Fig. 1. Southwest (summer) monsoon withdrew from the entire country on 16 October 2001, simultaneously, northeast monsoon rains commenced over Tamil Nadu & Pondicherry, Kerala and adjoining states of Karnataka and Andhra Pradesh. The northeast monsoon rainfall (October-December) over Telangana and Rayalaseema was *excess*†, over coastal Andhra Pradesh, coastal Karnataka, north interior Karnataka, south interior Karnataka & Kerala was *normal* and over Tamil Nadu and Lakshadweep, it was *deficient*. Northeast monsoon rains ceased in Tamil Nadu & Pondicherry, Kerala and adjoining states of Karnataka and Andhra Pradesh on 11 January 2002.

There was good rainfall activity in October almost all over India except northwest India. It was subdued in the country except over Peninsular India in the months of November and December 2001.

2. Seasonal rainfall (October-December)

Seasonal rainfall was *excess* in 14; *normal* in 9, *deficient* in 9 and *scanty* in 3 meteorological sub-divisions.

Rainfall was *excess* in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Jharkhand, Bihar, east Uttar Pradesh, east Madhya Pradesh & Chattisgarh, Madhya Maharashtra, Marathwada, Vidarbha, Telangana and Rayalaseema; *normal* in Andaman & Nicobar Islands, Orissa, west Madhya Pradesh, Gujarat Region, coastal Andhra Pradesh, coastal Karnataka, north interior Karnataka, south interior Karnataka and Kerala; *deficient* in west Uttar Pradesh, Himachal Pradesh, Jammu & Kashmir, west Rajasthan, east Rajasthan, Saurashtra & Kutch, Konkan & Goa, Tamil Nadu and Lakshadweep and *scanty* in Uttaranchal, Haryana and Punjab. 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 (summer) monsoon withdrew from the entire country on 16 October 2001.

3.1.2. *Onset of northeast monsoon*

Northeast monsoon rains commenced over Tamil Nadu & Pondicherry, Kerala and adjoining states of Karnataka and Andhra Pradesh on 16 October.

3.1.3. *Storms/depressions*

During the month of October, two cyclonic storms formed; one over the Arabian Sea and other over the Bay of Bengal. Details are presented below:

3.1.3.1. *Cyclonic storm over the Arabian Sea (8-10 October 2001)*

A well-marked low pressure area covering south Madhya Maharashtra, south Konkan & Goa and adjoining coastal Karnataka and east-central Arabian Sea formed on 8 evening. It concentrated into a depression at 2100 UTC of 8 near Lat. 18.3° N/ Long. 71.0° E. Moving in a northwesterly direction, it rapidly intensified into a deep Depression at 0300 UTC of 9 near Lat. 18.5° N/ Long. 70.0° E. Then, it moved in a northwesterly direction and further rapidly intensified into a cyclonic storm at 0900 UTC of 9 near Lat. 19.0° N/ Long. 68.5° E. Moving in a westerly direction, it weakened into a deep depression at 0300 UTC of 10 near Lat. 19.0° N/ Long. 67.5° E and into a depression at 0900 UTC of 10 near Lat. 19.0° N/ Long. 67.5° E. It moved in a northeasterly direction and further weakened into a low pressure area over east-central Arabian Sea.

† Definitions of terms given in italics are given in the Appendix.

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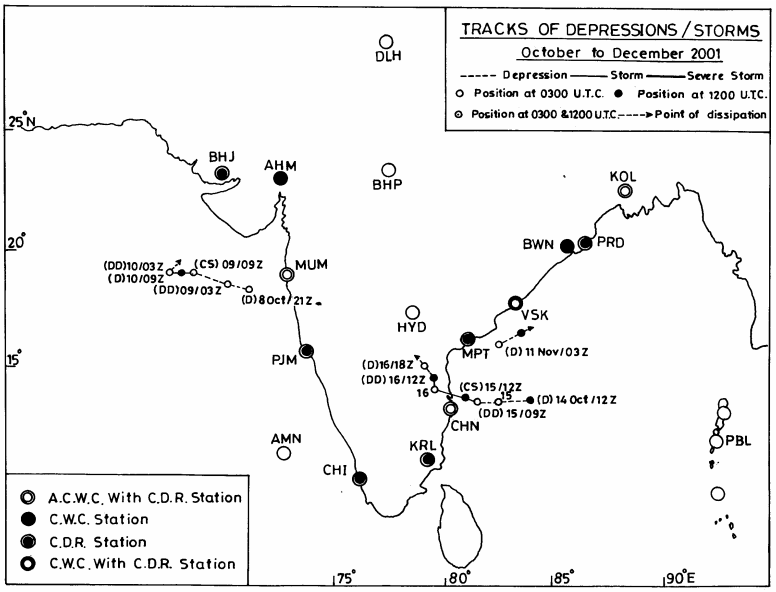

Fig. 1. Tracks of cyclonic storms during the period October to December 2001

The cyclone attained maximum 'T' number of T 2.5 (35 kts) from 0600 UTC to 2300 UTC of 9. The lowest estimated central pressure was 998 hPa at 1800 UTC of 9. Maximum estimated wind speed was 35 kts at 1800 UTC of 9. System initially moved in a westnorthwesterly to northwesterly direction and then recurved to northeasterly direction. The system dissipated over the Sea area.

As the system did not cross coast, it did not cause any damage. However, widespread rainfall occurred in Madhya Maharashtra on 7 and 8; in Konkan & Goa from 7 to 9 and in Gujarat on 8 and 9. Principal amounts of rainfall (cm) are :

7 October 2001 : Pune (Madhya Maharashtra) 3.9, Mumbai (Konkan) 2.4.

8 October 2001 : Pune (Madhya Maharashtra) 4.9, Alibag (Konkan) 4.8, Solapur (Madhya Maharashtra) 4.6, Silvasa (Gujarat Region) 4.4, Veraval (Saurashtra & Kutch) 2.5, and Umbergaon (Gujarat Region) 2.7.

9 October 2001 : Khambha (Saurashtra & Kutch) 10.5, Dharampur (Gujarat Region) 3.8, Bansda (Gujarat Region) 3.5, Madhuban (Gujarat Region) 3.3 and Silvasa (Gujarat Region) 3.0.

3.1.3.2. *Cyclonic storm over the Bay of Bengal (14-17 October 2001)*

A low pressure area covering west-central and adjoining southwest Bay off north Tamil Nadu-south

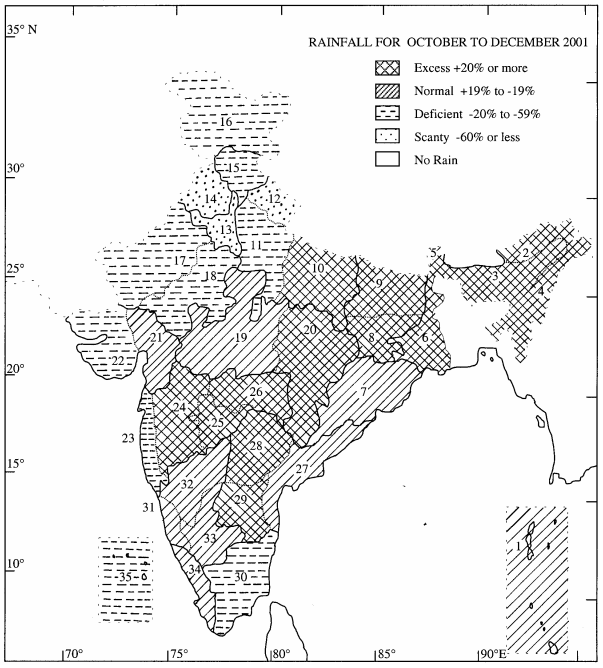

Fig. 2. Sub-divisionwise seasonal rainfall departure from normal (%) for Post monsoon season (October to December 2001). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 35 sub-divisions are indicated below :

1	–3	**8**	73	**15**	–49	**22**	–43	**29**	65
2	56	**9**	185	**16**	–41	**23**	–39	**30**	–22
3	28	**10**	53	**17**	–34	**24**	36	**31**	5
4	53	**11**	–55	**18**	–45	**25**	130	**32**	12
5	129	**12**	–81	**19**	6	**26**	81	**33**	–15
6	26	**13**	–60	**20**	45	**27**	16	**34**	0
7	–3	**14**	–70	**21**	1	**28**	42	**35**	–33

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (October-December 2001)

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	269	321	-16	322	253	27	130	171	-24	721	744	-3
2.	Arunachal Pradesh	207	121	71	23	24	0	13	11	18	243	156	56
3.	Assam & Meghalaya	219	159	38	29	27	4	4	10	-62	251	197	28
4.	Naga., Mani, Mizo and Tri.	233	150	55	59	32	84	1	9	-94	292	191	53
5.	Sub-Himalayan West Bengal & Sikkim	349	143	144	25	17	51	6	6	-1	380	165	129
6.	Gangetic West Bengal	163	114	43	8	19	-58	0	3	-100	171	136	26
7.	Orissa	120	120	0	31	29	5	0	6	-100	151	155	-3
8.	Jharkhand	173	84	106	0	12	-99	0	5	-100	173	100	73
9.	Bihar	214	63	237	0	8	-100	0	3	- 100	214	75	185
10.	East Uttar Pradesh	86	49	78	4	5	-16	0	6	-100	91	59	53
11.	West Uttar Pradesh	20	34	-43	1	4	-69	0	8	-99	21	47	-55
12.	Uttaranchal	9	59	-84	1	8	-87	7	25	-73	17	93	-81
13.	Haryana, Chandigarh & Delhi	11	19	-43	0	3	-97	1	8	-82	12	30	-60
14.	Punjab	4	23	-83	2	4	-55	7	15	-54	12	41	-70
15.	Himachal Pradesh	3	43	-93	15	13	12	30	39	-23	48	95	-49
16.	Jammu & Kashmir	9	32	-74	41	28	44	20	56	-64	70	117	-41
17.	West Rajasthan	6	5	23	0	1	-100	0	3	-98	6	9	-34
18.	East Rajasthan	12	14	-13	0	4	-100	0	4	-100	12	22	-45
19.	West Madhya Pradesh	58	33	77	0	15	-98	0	7	-100	58	55	6
20.	East M. P. & Chattisgarh	89	50	78	4	11	-62	0	9	-100	101	70	45
21.	Gujarat Region	38	27	40	0	9	-100	0	2	-100	38	37	1
22.	Saurashtra & Kutch	15	16	-4	0	10	-100	0	1	-100	15	26	-43
23.	Konkan & Goa	88	113	-22	2	25	-90	0	9	-100	91	147	-39
24.	Madhya Maharashtra	131	71	84	15	29	-50	0	7	-98	146	108	36
25.	Marathwada	191	57	236	4	19	-79	0	9	-100	196	85	130
26.	Vidarbha	127	46	174	5	16	-70	0	11	-100	132	73	81
27.	Coastal Andhra Pradesh	239	191	26	105	98	8	16	23	-28	361	311	16
28.	Telangana	140	76	85	3	19	-84	0	7	-100	143	101	42
29.	Rayalaseema	299	115	160	28	73	-61	25	26	-6	352	214	65
30.	Tamil Nadu	166	195	-15	132	194	-32	72	88	-18	370	478	-22
31.	Coastal Karnataka	227	196	16	69	70	-2	1	16	-94	297	283	5
32.	North Interior Karnataka	147	97	51	1	29	-95	2	8	-79	150	134	12
33.	South interior Karnataka	128	147	-13	48	53	-9	3	13	-73	180	212	-15
34.	Kerala	320	297	8	178	166	7	11	43	-75	509	506	0
35.	Lakshadweep	106	163	-35	102	102	0	17	69	-76	224	334	-33

Andhra coast formed on 14 morning. It concentrated into a depression at 1200 UTC of 14 near Lat. 13.5° N/ Long. 84.0° E. Moving in a westerly direction, it rapidly intensified into a deep depression at 0900 UTC of 15 near Lat. 13.5° N/ Long. 81.5° E. Then, moving in a northwesterly direction, it further rapidly intensified into a cyclonic storm at 1200 UTC of 15 near Lat. 13.7° N/ Long. 81.0° E. It moved in a northwesterly direction and made a landfall near Nellore around 0000 UTC of 16 and lay centred as a cyclonic storm at 0300 UTC of 16 near Lat. 14.0° N/ Long. 79.5° E. It moved in a northerly to northwesterly direction and weakened into a deep depression at 1200 UTC of 16 near Lat. 14.5° N/ Long. 79.5° E and into a depression at 1800 UTC of 16 near Lat. 15.0° N/ Long. 79.0° E. The system further weakened into a well-marked low pressure area over Rayalaseema on 17 without any appreciable movement.

The cyclonic storm attained maximum 'T' number of T 2.5 (35 kts) from 1200 UTC of 15 to 0300 UTC of 16. The lowest estimated central pressure was 996 hPa at 0000 UTC of 16. The estimated maximum wind speed was 35 kts from 1200 UTC of 15 to 0300 UTC of 16. No significant storm surge occurred in the coastal belt.

The system produced exceptionally heavy rainfall in Nellore, Srikakulam, East Godavari and Chittoor districts of coastal Andhra Pradesh and heavy rainfall in Tamil Nadu. Principal amounts of rainfall (cm) are :

15 October 2001 : Arakonam (Tamil Nadu) 7.6 and Vandhalai (Tamil Nadu) 7.2.

16 October 2001 : Sulurpet (Coastal Andhra Pradesh) 26.1, Nellore (coastal Andhra Pradesh 24.9, Red Hills (Tamil Nadu) 13.5, Thamaraipakkam (Tamil Nadu) 12.2, Puttur (coastal Andhra Pradesh) 10.6, Amlapuram (coastal Andhra Pradesh) 10.5, Tiruvallur (Tamil Nadu) 10.2 and Rapur (coastal Andhra Pradesh), Chennai (Tamil Nadu), Poondi (Tamil Nadu) 10.0 each.

17 October 2001 : Gudur (coastal Andhra Pradesh) 15.2, Thambalapalle (coastal Andhra Pradesh) 13.1, Sitaramapuram (coastal Andhra Pradesh) 11.4, Tekkali (coastal Andhra Pradesh) 7.2 and Peddapuram (coastal Andhra Pradesh) 6.8.

The system caused some damage due to very heavy rainfall in coastal Andhra Pradesh as given below:

Number of deaths	:	108 (Mainly due to heavy rains)
Number of person missing	:	21
Districts affected	:	Nellore (coastal Andhra Pradesh), Chittoor (coastal Andhra Pradesh) and Cuddapah (Rayalaseema)
Number of tanks breached	:	1,635
Damage to crop	:	1,25,000 hectares (Paddy, Groundnut, pulses etc.)
Number of Cattle killed	:	1000 approx.
Number of houses damaged	:	55,747
Estimated loss	:	Rs. 500 crores
Roads damaged	:	NHS and R & H roads in Nellore & Chittoor districts

The system did not produce any reportable damage in Tamil Nadu.

3.1.4. *Weather and associated synoptic features*

Table 2 gives details of synoptic features for the month of October 2001.

Southwest/northeast monsoon was *vigorous* on 4 to 5 days in Sub-Himalayan West Bengal & Sikkim, Bihar, Madhya Maharashtra, Marathwada, Telangana and Rayalaseema; and on 1 to 3 days in Arunachal Pradesh, Gangetic West Bengal, Orissa, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, coastal Andhra Pradesh, coastal Karnataka, north interior Karnataka and Kerala. It was *active* on 4 to 5 days in coastal Andhra Pradesh, Telangana, Rayalaseema and Kerala; and on 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Orissa, Bihar, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, Konkan & Goa, coastal Karnataka, north interior Karnataka and south interior Karnataka.

Very heavy rainfall occurred on 4 to 6 days in Bihar, Tamil Nadu and Kerala; and on 1 to 3 days in Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Orissa, Madhya Maharashtra, Marathwada, Vidarbha, coastal Andhra Pradesh, Rayalaseema, north interior Karnataka and south interior Karnataka. *Heavy* rain also occurred on 4 to 7 days

TABLE 2

Details of the weather systems during October 2001

S. No.	System	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Storms*					
1.	Cyclonic storm	8-10	East-Central Arabian Sea	First north-westerly, then westerly and finally in northeasterly direction	East-central Arabian Sea	A well-marked low pressure area lay over south Madhya Maharashtra, south Konkan & Goa and adjoining coastal Karnataka and east-central Arabian Sea and concentrated into a depression at 2100 UTC of 8 near Lat. 18.3° N/ Long. 71.0° E. Moving in a northwesterly direction, it rapidly intensified into a Deep Depression at 0300 UTC of 9 near Lat. 18.5° N/ Long. 70.0° E. Then, it moved in a northwesterly direction and further rapidly intensified into a Cyclonic Storm at 0900 UTC of 9 near Lat. 19.0° N/ Long. 68.5° E. Moving in a westerly direction, it weakened into a Deep Depression at 0300 UTC of 10 near Lat. 19.0° N/ Long. 67.5° E and into a depression at 0900 UTC of 10 near Lat. 19.0° N/ Long. 67.5° E. It moved in a northeasterly direction and further weakened into a low pressure area over east-central Arabian Sea
2.	Cyclonic storm	14 – 17	West-central and adjoining southwest Bay off north Tamil Nadu-south Andhra coast	Initially westerly, then northwesterly and finally northerly to northwesterly	Rayalaseema	A low pressure area formed over west-central and adjoining southwest Bay off north Tamil Nadu-south Andhra coast on 14 morning. It concentrated into a depression at 1200 UTC of 14 near Lat. 13.5° N/ Long. 84.0° E. Moving in a westerly direction, it rapidly intensified into a deep depression at 0900 UTC of 15 near Lat. 13.5° N/ Long. 81.5° E. Then, moving in a northwesterly direction, it further rapidly intensified into a cyclonic storm at 1200 UTC of 15 near Lat. 13.7° N/ Long. 81.0° E. It moved in a northwesterly direction and made a landfall near Nellore around 0000 UTC of 16 and lay centred as a cyclonic storm at 0300 UTC of 16 near Lat. 14.0° N/ Long. 79.5° E. It moved in a northerly to northwesterly direction and weakened into a deep depression at 1200 UTC of 16 near Lat. 14.5° N/ Long. 79.5° E and into a depression at 1800 UTC of 16 near Lat. 15.0° N/ Long. 79.0° E. The system further weakened into a well-marked low pressure area over Rayalaseema on 17 without any appreciable movement
(**B**)	*Low pressure areas*					
1.	Low pressure area	20 – 26	Southeast Bay and adjoining Andaman Sea	Stationary	*In situ*	It was first observed as a cyclonic circulation over south Andaman Sea and neighbourhood on 19. Associated cyclonic circulation extended upto mid tropospheric levels. It was seen as a trough of low on sea level over southwest and adjoining southeast Bay off Sri Lanka-south Tamil Nadu coast from 23 to 26
2.	Low pressure area	24 – 30	North Andaman Sea and adjoining east-central Bay and Arakan coast	Westerly	Northwest Bay and adjoining areas of West Bengal and Orissa	Associated cyclonic circulation extended upto mid tropospheric levels which became less marked on 2 November

TABLES 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**C**)	*Trough of low*					
1.	Sea level	12 – 27	Gujarat to Lakshadweep	Quasi-stationary	North Karnataka coast to Lakshadweep	
2.	Do	20 – 21	West-central Arabian Sea	Stationary	*In situ*	Moved away westwards
3.	Do	31 Oct – 2 Nov	Southeast Bay to Sub-Himalayan West Bengal & Sikkim through west-central and north Bay	Westerly	Southwest Bay to north Bay through west-central Bay	
(**D**)	*Other cyclonic circulations*					
1.	Mid tropospheric levels	1 – 7	South Pakistan and adjoining west Rajasthan	Northeasterly	Northwest Rajasthan and neighbourhood	
2.	Do	2 – 6	North Pakistan and adjoining Jammu & Kashmir	Do	Jammu & Kashmir and neighbourhood	Moved away northeastwards.
3.	Do	29	Lakshadweep area	Stationary	*In situ*	It was seen as a trough in the lower levels from south interior Karnataka to Lakshadweep on 30 and from southwest Bay to Lakshadweep on 31
4.	Do	30-31	Punjab and adjoining Haryana and Jammu & Kashmir	Quasi-stationary	Himachal Pradesh and neighbourhood	
5.	Mid tropospheric levels	31	North Pakistan and adjoining Jammu & Kashmir	Stationary	*In situ*	
6.	Do	31	Southwest Bay of Tamil Nadu-south Andhra coast	Stationary	*In situ*	
(**E**)	*North-south troughs*					
1.	Lower levels	10 – 12	Sub-Himalayan West Bengal to Gangetic West Bengal	Quasi-stationary	Sub-Himalayan West Bengal & Sikkim to Orissa	
(**F**)	*Troughs in westerly*					
1.	Lower levels	18 – 20	Sub-Himalayan West Bengal & Sikkim to Chattisgarh	Easterly	Sub-Himalayan West Bengal to north Bay	
(**G**)	*Other troughs*					
1.	Lower tropospheric levels	6 – 8	North Bihar to Chattisgarh	Northeasterly	Sub-Himalayan West Bengal to north Bihar	
(**H**)	*Western disturbances*					
1.	As an upper air cyclonic circulation	6 – 10	Central Pakistan	Eastnorth-easterly	Jammu & Kashmir and neighbourhood	Moved away northeastwards
2.	Do	10 – 15	South Pakistan and adjoining west Rajasthan	Do	Do	Do
3.	Do	15 -17	Central Pakistan	Do	Do	Do
4.	Do	17-22	Do	Do	Jammu & Kashmir and adjoining Punjab and Rajasthan	Do
5.	Do	22-24	Do	Do	Jammu & Kashmir and neighbourhood	Do
6.	Do	25-26	Central Pakistan and adjoining west Rajasthan and Punjab	Do	North Pakistan and adjoining Jammu & Kashmir	Do

Assam & Meghalaya, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Orissa, Madhya Maharashtra, Tamil Nadu, coastal Karnataka, south interior Karnataka and Kerala; and on 1 to 3 days in Andaman & Nicobar Islands, Arunachal Pradesh, Nagaland-Manipur-Mizoram-Tripura, Bihar, east Uttar Pradesh, west Madhya Pradesh, Gujarat Region, Marathwada, Vidarbha, coastal Andhra Pradesh, Telangana, Rayalaseema and north interior Karnataka.

3.1.5. *Monthly rainfall*

Monthly rainfall for the month of October 2001 was *excess* in 19 (Arunachal Pradesh, Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Jharkhand, Bihar, east Uttar Pradesh, west Rajasthan, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, Gujarat Region, Madhya Maharashtra, Marathwada, Vidarbha, coastal Andhra Pradesh, Telangana, Rayalaseema and north interior Karnataka), *normal* in 8 (Andaman & Nicobar Islands, Orissa, east Rajasthan, Saurashtra & Kutch, Tamil Nadu, coastal Karnataka, south interior Karnataka and Kerala), *deficient* in 4 (west Uttar Pradesh, Haryana, Konkan & Goa and Lakshadweep) and *scanty* in 4 (Uttaranchal, Punjab, Himachal Pradesh and Jammu & Kashmir) meteorological sub-divisions. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.1.6. *Temperature*

In the regions from where southwest monsoon withdrew, the day temperatures were *appreciably to markedly above normal* on 18 to 24 days in some parts of Himachal Pradesh, Jammu & Kashmir, west Rajasthan, east Rajasthan, west Madhya Pradesh, Gujarat Region and of Saurashtra & Kutch; on 8 to 14 days in some parts of Assam & Meghalaya, Orissa, east Madhya Pradesh & Chattisgarh and of Konkan & Goa; on 4 to 7 days in some parts of Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, east Uttar Pradesh, Haryana, coastal Andhra Pradesh and of coastal Karnataka; and on 1 to 3 days in some parts of Jharkhand, Bihar, west Uttar Pradesh, Uttaranchal, Madhya Maharashtra, Vidarbha, Telangana, Rayalaseema, Tamil Nadu, south interior Karnataka and of Kerala. They were *above normal* on 18 days in some parts of east Uttar Pradesh; on 8 to 12 days in some parts of Orissa, Jharkhand, Bihar, west Uttar Pradesh, Haryana, west Madhya Pradesh and of Tamil Nadu; on 4 to 7 days in some parts of Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Uttaranchal, Punjab, Jammu & Kashmir, west Rajasthan, east Rajasthan, east Madhya Pradesh & Chattisgarh, Gujarat Region, Saurashtra & Kutch, Konkan & Goa, Madhya Maharashtra, Vidarbha, coastal Andhra Pradesh, Telangana, Rayalaseema and of coastal Karnataka; and on 1 to 3 days in some parts of Himachal Pradesh, Marathwada, north interior Karnataka, south interior Karnataka and of Kerala. Day temperatures were *appreciably to markedly below normal* on 1 to 4 days in some parts of north India during first week of the month and over Peninsular India in the second fortnight of the month. They were generally normal over the rest of the country.

The month's highest maximum temperature in the plains of the country was 42^{o} C recorded at Barmer (west Rajasthan) on 8 and 9 October 2001.

In the regions from where southwest monsoon withdrew, night temperatures were *appreciably to markedly below normal* on 8 to 9 days in some parts of Gujarat Region and of Madhya Maharashtra; on 3 to 5 days in Punjab, west Rajasthan, east Rajasthan, Saurashtra & Kutch, Marathwada, Vidarbha and of Telangana; and on 1 to 2 days in some parts of Sub-Himalayan West Bengal & Sikkim, Jharkhand, east Uttar Pradesh, Jammu & Kashmir, west Madhya Pradesh, Konkan & Goa, Rayalaseema, coastal Karnataka, north interior Karnataka and of south interior Karnataka. They were *below normal* on 4 to 6 days in some parts of Orissa, Jharkhand, west Rajasthan, east Rajasthan, west Madhya Pradesh, Madhya Maharashtra, Vidarbha, Telangana and of south interior Karnataka; and on 1 to 3 days in some parts of Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Bihar, east Uttar Pradesh, west Uttar Pradesh, Uttaranchal, Haryana, Punjab, Jammu & Kashmir, east Madhya Pradesh & Chattisgarh, Gujarat Region, Saurashtra & Kutch, Konkan & Goa, Marathwada, coastal Andhra Pradesh, Rayalaseema, Tamil Nadu and of north interior Karnataka. They were generally *appreciably to markedly above normal* on most of the days in the first half and in the last week of the month over north and central India.

The month's lowest minimum temperature in the plains of the country was 7° C recorded at Malegaon (Madhya Maharashtra) on 26 October 2001.

3.1.7. *Disastrous weather events and associated damages*

Apart from the damages caused due to two cyclonic storms, 39 people (18 each in West Bengal & Sikkim and Karnataka and 3 in Maharashtra) died due to *heavy* rains. Road link between Darjeeling and Sikkim disconnected due to landslide.

TABLE 3

Details of the weather systems during November 2001

S. No.	System	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**) *Depressions*						
1.	Depression	11	Southwest and adjoining west-central Bay off south Andhra-north Tamil Nadu coasts	Stationary	*In Situ*	It was first observed as a cyclonic circulation at mid tropospheric levels on 1. It became low pressure area on 7 and became well-marked on 9. A trough from this system over southwest Bay extended westsouthwestwards upto Lakshadweep across Rayalaseema, south interior Karnataka and Kerala from 10 to 12. A well-marked low pressure area over southwest Bay and adjoining west-central bay off north Tamil Nadu-south Andhra coasts concentrated into a depression at 0300 UTC of 11 near Lat. 16.0° N/Long. 82.5° E. Moving in a northeasterly direction, it lay centred at 1200 UTC of 11 near Lat. 16.5° N/Long. 83.5° E, about 150 kms south of Visakhapatnam and subsequently, it weakened into a well-marked low pressure area over west-central and adjoining northwest Bay on 12. It was observed as a cyclonic circulation at mid tropospheric levels over east-central Arabian Sea off west coast from 12 to 14. It was seen as a trough from 12 to 14. It was seen as a trough from south Konkan-Goa to Lakshadweep area from 15 to 21 and from southeast to east-central Arabian Sea from 22-24. It lay as a trough of low over southeast Arabian Sea from 25 November to 1 December and over southwest Arabian Sea from 2 December to 4 December. It became less marked on 5
(B) *Low pressure area*						
1.	Low pressure area	3 – 4	Central Pakistan and adjoining northwest Rajasthan and Punjab	Stationary	*In situ*	Associated cyclonic circulation extended upto mid tropospheric levels. It lay over Punjab and adjoining areas of Haryana, Himachal Pradesh and Jammu & Kashmir on 4 and less marked on 5
(**C**) *Trough of low*						
1.	Sea level	13 Nov - 12 Dec	Southwest Bay to north Bay through west-central Bay	Quasi-stationary	Do	It persisted with an embedded cyclonic circulation over southwest Bay and adjoining areas of south Tamil Nadu and Sri Lanka on 22 and 23. The embedded cyclonic circulation became less marked on 24
2.	Do	20 – 23	South Andaman Sea and adjoining southeast Bay	Westerly	Southeast Bay	Merged with the above trough of low
3.	Do	24 Nov – 1 Dec	Andaman Sea	Do	Southeast Bay on 25	Do
(**D**) *Western disturbances*						
(1)	Upper air system	19 – 24	North Pakistan and adjoining Jammu & Kashmir	Do	Uttaranchal and adjoining Himachal Pradesh	

TABLES 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(E)	*Cyclonic circulations*					
1.	Mid tropospheric levels	3 – 4	Lakshadweep area off south Karnataka-Kerala coasts	Stationary	*In situ*	
2.	Lower tropospheric levels	4 – 5	South Andaman Sea	Westerly	Andaman Sea and adjoining southeast Bay	
3.	Mid tropospheric levels	5 – 10	North Pakistan and adjoining Jammu & Kashmir and Punjab	Northeasterly	Jammu & Kashmir	
4.	Do	6 – 10	Central Pakistan and adjoining Rajasthan	Northeasterly	West Uttar Pradesh and adjoining Haryana and Uttaranchal	It was seen as a trough on 9 over west Uttar Pradesh and adjoining Haryana and Uttaranchal
5.	Do	7 – 8	Lakshadweep area off Karnataka-Kerala coast	Stationary	*In situ*	It was first observed as a trough of low over Lakshadweep area to east-central Arabian Sea off Kerala-Karnataka coasts on 6
6.	Do	11 – 14	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Jammu & Kashmir	
7.	Mid tropospheric levels	15 – 16	North Pakistan and adjoining parts of Punjab and Jammu & Kashmir	Northeasterly	North Rajasthan and adjoining areas of Punjab and Haryana	
8.	Lower tropospheric levels	15 – 17	Southern parts of Tamil Nadu and adjoining parts of Sri Lanka and southwest Bay	Westerly	Kerala and adjoining south Tamil Nadu and Lakshadweep area	
9.	Lower levels	21 – 23	West Rajasthan and adjoining south Pakistan	Do	Central Parts of Rajasthan	
10.	Mid tropospheric levels	23 – 28	North Pakistan and adjoining Jammu & Kashmir	Do	West Uttar Pradesh and adjoining areas of Uttaranchal and Haryana	
11.	Lower tropospheric levels	25 – 26	South Pakistan and adjoining areas of west Rajasthan	Stationary	*In situ*	
12.	Mid tropospheric levels	27 – 30	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Punjab and adjoining areas	It was seen as a trough on 30 over west Uttar Pradesh and adjoining Uttaranchal and became less marked on 1 December
13.	Do	29 Nov - 3 Dec	Pakistan and adjoining Jammu & Kashmir	Northeasterly	Jammu & Kashmir	Moved away northeastwards

3.2. *November*

3.2.1. *Storms/depressions*

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

3.2.1.1. *Depression over the Bay of Bengal (11 November 2001)*

A well-marked low pressure area over southwest Bay and adjoining west-central Bay off north Tamil Nadu-south Andhra coasts concentrated into a depression at 0300 UTC of 11 near Lat. 16.0° N/ Long. 82.5° E. Moving in a northeasterly direction, it weakened into a well-marked low pressure area over west-central and adjoining northwest Bay on 12.

The system attained maximum intensity of T 1.5 as estimated from INSAT cloud imageries from 2100 UTC of 10 to 0000 UTC of 12.

As the system dissipated over the sea area, no damage was reported. However, widespread to fairly widespread rainfall occurred over coastal Andhra Pradesh and Orissa during the period. Significant amounts of rainfall in cm are :

10 November 2001 : Gopalpur (Orissa) 6, Kalingapatnam (costal Andhra Pradesh) 5; and Paradip (Orissa) 3.

11 November 2001 : Visakhapatnam (coastal Andhra Pradesh) 8, Paradip (Orissa) 6, Waltair (coastal Andhra Pradesh) 5, Kakinada, Kalingapatnam, Tuni (all coastal Andhra Pradesh) 2 each; and Bhubaneswar, Puri, Gopalpur, Balasore (all Orissa) 1 each.

12 November 2001 : Puri (Orissa), Kalingapatnam (coastal Andhra Pradesh) 7 each; Gopalpur, Paradip (both Orissa), Waltair (coastal Andhra Pradesh) 6 each, Bhubaneswar (Orissa) 3; and Cuttack (Orissa) 1.

3.2.2. *Weather and associated synoptic features*

Details of synoptic features for the month of November 2001 are given in Table 3.

Northeast monsoon was *active* on 3 days in Kerala

Very heavy rainfall occurred on 2 days in coastal Andhra Pradesh and on 1 day in south interior Karnataka. *Heavy* rainfall also occurred on 13 days in Tamil Nadu, 9 days in Kerala, 4 days in coastal Andhra Pradesh; and on 1 to 2 days in Andaman & Nicobar Islands, Sub-Himalayan West Bengal & Sikkim, Orissa and coastal & south interior Karnataka.

Rain or thundershowers occurred either at *most places* or *at many places* on 11 days in Andaman & Nicobar Islands; on 3 to 4 days in Orissa, Jammu & Kashmir, coastal Andhra Pradesh and Kerala; and on 1 to 2 days in Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Uttaranchal, Himachal Pradesh, Madhya Maharashtra, Tamil Nadu, coastal Karnataka, south interior Karnataka and Lakshadweep; and either at *a few places* or at *isolated places* on 8 to 28 days over northeast India, Gangetic West Bengal, Orissa and Peninsular India.

3.2.3. *Monthly rainfall*

Monthly rainfall for the month of November 2001 was *excess* in 4 (Andaman & Nicobar Islands, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim and Jammu & Kashmir), *normal* in 10 (Arunachal Pradesh, Assam & Meghalaya, Orissa, east Uttar Pradesh, Himachal Pradesh, coastal Andhra Pradesh, coastal Karnataka, south interior Karnataka, Kerala and Lakshadweep; *deficient* in 4 (Gangetic West Bengal, Punjab, Madhya Maharashtra and Tamil Nadu) and *scanty* in 12 (Jharkhand, west Uttar Pradesh, Uttaranchal, Haryana, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, Konkan & Goa, Marathwada, Vidarbha, Telangana, Rayalaseema and north interior Karnataka) meteorological sub-divisions. There was no rain in the remaining 5 (Bihar, west Rajasthan, east Rajasthan, Gujarat Region and Saurashtra & Kutch) meteorological sub-divisions. 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 11 days in some parts of Gujarat Region; on 7 days each in some parts of Saurashtra & Kutch and Madhya Maharashtra and on 1 to 2 days in some parts of Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Haryana, Punjab, Jammu & Kashmir, west Rajasthan, Vidarbha, coastal Andhra Pradesh, Tamil Nadu and of south interior Karnataka. They were *below normal* on 11 days in some parts of Madhya Maharashtra; on 3 to 5 days in some parts of Punjab, Jammu & Kashmir, west

TABLE 4

Details of the weather systems during December 2001

S. No.	System	Period	Place of first location	Direction of movement	Place of dissipation	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Low pressure area*					
1.	Well-marked low pressure area	29Dec – 2 Jan 2002	Southern parts of southeast Bay and adjoining areas of south Andaman Sea	Stationary	*In situ*	It was first observed as a trough of low on 29 over the same area. It became low pressure area on 1 Jan 2002. It was again observed as a trough of low from 2 January onwards
(B)	*Trough of low pressure area*					
1.	Sea level	13 – 29	Southwest Bay and adjoining areas of Andaman Sea	Easterly	Southwest Arabian Sea	
2.	Do	13 – 29	Southeast Bay and adjoining areas of Andaman Sea	Westerly	Do	
3.	Do	19 – 22	Lakshadweep area and adjoining southeast Arabian Sea off Kerala coast	Westerly	South Arabian Sea	Became unimportant
4.	Do	20 – 21	Southeast Bay to Andaman Sea	Stationary	*In situ*	Merged with trough of low from Comorian area to west-central Bay
5.	Do	23 Dec – 9 Jan 2002	Southwest Bay	Northeasterly	Southeast Arabian Sea to south Gujarat coast	
(**C**)	*Western disturbances*					
1.	Upper air system	13 – 14	Jammu & Kashmir and neighbourhood	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away northeastwards
2.	Do	22 – 27	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Haryana and adjoining areas of Rajasthan, Punjab and west Uttar Pradesh	Moved away northeastwards
(**D**)	*Induced cyclonic circulations*					
1.	Mid tropospheric level	15 – 17	Central Pakistan and adjoining west Rajasthan	Northeasterly	West Uttar Pradesh and adjoining areas of Punjab, Haryana and Uttaranchal	
(E)	*Other cyclonic circulations*					
1.	Mid tropospheric levels	4 – 9	North Pakistan and adjoining Jammu & Kashmir	Easterly	Jammu & Kashmir	
2.	Lower levels	7 – 8	South Pakistan and adjoining west Rajasthan	Stationary	*In situ*	
3.	Mid tropospheric levels	9 – 14	North Pakistan and Jammu & Kashmir	Eastnorth-easterly	Uttaranchal and adjoining west Uttar Pradesh	

TABLES 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.	Mid tropospheric levels	10 – 13	Central Pakistan and adjoining areas of Rajasthan	Easterly	West Madhya Pradesh and neighbourhood	
5.	Do	12 – 13	North Pakistan and adjoining areas of Jammu & Kashmir	Stationary	*In situ*	
6.	Do	15 – 16	South Tamil Nadu and adjoining areas of Sri Lanka and southwest Bay	Do	Do	
7.	Do	16 – 21	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Jammu & Kashmir and neighbourhood	Moved away northeastwards
8.	Do	25 Dec – 1 Jan 2002	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Do
(**F**)	*Trough*					
1.	Sea level	2 – 10	Lakshadweep area off Kerala – Karnataka coasts	Westerly	Southeast Arabian Sea and adjoining Lakshadweep area	It became unimportant after 10
2.	Do	10 – 12	Lakshadweep area off Kerala coast	Stationary	*In situ*	Merged with the embedded cyclonic circulation on 12

Rajasthan, Gujarat Region, Saurashtra & Kutch, Marathwada and of Vidarbha and on 1 to 2 days in some parts of Sub-Himalayan West Bengal & Sikkim, Orissa, Bihar, east Uttar Pradesh, west Uttar Pradesh, Uttaranchal, Haryana, east Rajasthan, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, Konkan & Goa, Telangana, Rayalaseema, Tamil Nadu, north interior Karnataka and of south interior Karnataka. Night temperatures were generally either *appreciably to markedly above normal* or *above normal* on many days over the country on rest of the days.

Month's lowest minimum temperature in the plains of the country was 5.0° C recorded at Adampur (Punjab) on 28 November 2001.

3.2.5. *Disastrous weather events and associated damages*

According to press reports, landslide in Kerala took a toll of 41 human lives. Chikkderarayasagara Canal breached on 6 November resulting in inundation of hundreds of acres of land and leading to derailment of a goods train. Nearly 1.5 crores worth of property was damaged.

Sandakphu Range (Darjeeling) experienced heavy snowfall on 22 November.

3.3. *December*

3.3.1. *Storms/depressions*

No System formed during the month.

3.3.2. *Weather and associated synoptic features*

Table 4 gives the details of synoptic features for the month of December 2001.

Very heavy rain occurred on 3 days in Tamil Nadu. *Heavy* rain also occurred on 5 days in coastal Andhra Pradesh, on 3 days in Tamil Nadu and on 1 day in Andaman & Nicobar Islands.

Rain or thundershowers occurred either *at most places* or at *many places* on 1 to 3 days in Arunachal Pradesh, Uttaranchal, Punjab, Himachal Pradesh, Jammu & Kashmir and Tamil Nadu. Rain or thundershowers also occurred either at *a few places* or at *isolated places* on 19 days in Tamil Nadu; on 10 to 13 days in coastal Andhra Pradesh, Rayalaseema and Kerala; on 4 to 7 days in Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim, south interior Karnataka and Lakshadweep and on 1 to 3 days in Assam & Meghalaya, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, west Rajasthan, Konkan & Goa and coastal & north interior Karnataka.

TABLE 5

Principal amounts of rainfall (cm) (1 cm and above)

Date	October	November	December
(1)	(2)	(3)	(4)
1.	Chottabekra 19, Washim 18, Ahmedpur & Chakur 15 each, Nanded & Bidar 13 each, Mangalore & Karkala 12 each, Amraghat 11, Annapurnaghat 10, Roing, Lakhipur & Akola 8 each, Araria & Shirali 7 each, Tezpur & Karwar 6 each, Latur & Shimoga 5 each, Sripalpur, Yeotmal & Madikeri 4 each, Namsai, Silchar, Kolasib, Ranchi, Patna, Agra, Yadagiri & Bangalore 3 each	Hut Bay 5, Baghdogra 4, Car Nicobar 3, Shillong, Agartala & Valparai 2 each	Kavali 8, Nellore 2, Hut Bay, Ongole, Chennai & Cuddalore 1 each
2.	Chatia & Bidar 13 each, Edlabad 10, Rajghat & Basua 9 each, Chouldhowaghat & Washim 8 each, Khowang, Naharkatia, Sonbarsa, Jhanjharpur & Shegaon 7 each, Madhabarida & Japla 6 each, Passighat, North Lakhimpur, Gorakhpur, Bhadgaon & Peddapuram 5 each, Balasore, Kanpur, Bhiwani, Narwana & Bhadrachalam 4 each, Port Blair, Namsai, Berhampore, Cuttack, Sarsawa, Rohtak, Bodeli, Aurangabad, Chepurupalli & Dundigal 3 each	Rentachintala 4, Chennai 3, Car Nicobar & Srinagar 1 each	Port Blair 4, Nagapattinam 3, Nellore, Chennai, Karaikal & Vellore 1 each
3.	Dengraghat 13, Basti FM 12, Kakrahi 10, Chargharia, Shegaon & Washim 8 each, Kursela, Basua, Ayodhya & Gorakhpur 7 each, Paratwada 5, Agartala 4	Pamban & Kasargod 5 each, Tirupathi & Vadakkancherry 3 each, Nellore 2, Maya Bandar, Quazi Gund & Bangalore 1 each	Nagapattinam 2
4.	Araria 18, Dengraghat 14, Lucknow 11, Jainagar 9, Agartala 7, Sonamura 6, Berhampore, Allahabad & Jamner 5 each, Selu 4, Nancowry, Dillighat, Gopalpur, Ambala & Soegaon 3 each	Batote 6, Pahalgam, Berthin & Vadakkancherry 5 each, Kanjirappally 3, Nancowry, North Lakhimpur & Chennai 1 each	Pamban, Tuticorin & Palayamkottai 3 each, Maya Bandar 2, Thiruvananthapuram 1
5.	Araria 21, Sonbarsa 19, Munger 17, Ballia 14, Manas NH X-ing, Jalpaiguri & Rewaghat 13 each, Turtipar 11, Beki Road Bridge 10, Colgaon, Jaunpur, Varanasi & Nagpur 9 each, Kakrahi & Aurangabad 8 each, Darjeeling & Malwan 7 each, Beki Mathanguri, Patna, Bhagalpur & Buxar 6 each, Bhalukpong, Balarampur, Yawal, Srirampur, Mul, Koderu & Madurai 5 each, Passighat, Gangtok, Khedbraham, Bhira, Vaijapur & Suryapet 4 each, Car Nicobar, Tezu, Cooch Behar, New Delhi, Danta, Vengurla, Panjim, Jamner, Kannad, Buldhana, Gadag & Chennai 3 each	Chittur 7, Kokrajhar 4, Dhundi, Chennai & Alapuzha 3 each, Hut Bay, Gangtok & Kakinada 2 each	Pamban & Tondi 1 each
6.	Chintamani 20, Dhubri 19, Araria & Chennai 17 each, Goalpara & Beki Mathanguri 14 each, Cooch Behar & Gaganbavada 13 each, Jalpaiguri 12, Tirupathi & Srinivaspura 11 each, Jainagar 10, Darjeeling, Arogyavaram, Baptala & Kolar Gold Field 9 each, Passighat, Taibpur, Galgalia, Nandyal, Pondicherry & Bidar 8 each, Ratnagiri, Kavali, Machilipatnam & Ongole 7 each, Tezu, Baghdogra, Vellore, Shirali, Vengurla, Kurnool & Nellore 5 each, Guwahati, Shillong, Shantiniketan, Hyderabad, Mudibidere, Bijapur, Sankeshwara & Cochi 4 each, Phulbani, Mumbai, Mahabaleshwar, Pune, Gannavaram, Narsapur, Ananthapur, Cuddalore, Panambur, Udupi, Honavar, Koppal, Alland & Bangalore 3 each	Kavali 14, Nagapattinam & Kochi 7 each, Malamelkadi 6, Ongole 5, Mangalore, Mandya & Arogyavaram 2 each, Nancowry & Quazi Gund 1 each	-
7.	Jamakhandi 14, Udupi 12, Kavali & Bijapur 11 each, Nellore & Mangalore 9 each, Sangli, Kumbum, Rajam-pet, Belgaum & Agumbe 7 each, Passighat & Cuddapah 6 each, Nancowry, Matizuri, Beki Mathanguri, Ongole & Tuni 5 each, Visakhapatnam, Dundigal, Kurnool, Nandyal & Bidar 4 each, Guwahati, Dibrugarh, Puri, Kolhapur, Bapatla, Nagarjunsagar Dam & Bellary 3 each	Kavali 20, Begur 14, Nellore 11, Srirangapattanam 7, Palayamkottai & Mani 5 each, Kondul, Bhang & Kochi 3 each, Silchar, Bahraich, Pantnagar, Arogyavaram & Bellary 1 each	Thiruvananthapuram 1
8.	Barsi 9, Bhalukpong & Ahmednagar 7 each, Patoda, Ongole, Uppinangaddy, Indi & Kasargod 6 each, Chouldhowaghat Tirupathi, Holagonda, Kumta, Udupi, Karkala, Bidar, Athani & Bagewadi 5 each, Alibag, Bhira, Pune, Sholapur, Kannur & Kochi 4 each, Amraghat, Gudari, Mahendragarh, Mahabaleshwar, Manjlegaon, Darsi, Jurala Project, Nagarjunsagar Dam & Prodattur 3 each	Puri & Chennai 7 each, Nagapattinam 6, Maya Bandar 5, Port Blair & Kavali 4 each, Panambur 3, Imphal & Thiruvananthapuram 2 each	Nancowry 2
9.	Thakurmunda & Dharampur 6 each, Mahabaleshwar & Salem 5 each, Silvasa, Panambur & Bidar 4 each, Car Nicobar, Seppa, Tadong, Jalpaiguri, Kolkata, Umbergaon, Vapi & Ghogha 3 each	Chennai 8, Perinthalamanna 7, Kalingapatnam & Konni 6 each, Taliparamba 5, Nancowry 3, Silchar 2, Paradip 1	Gangtok 5, Tadong 3, North Lakhimpur 1

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
10.	Kailashshahar 13, Gangtok & Khambha 11 each, Mantralayam 8, Thakurmunda, Khandwa & Raipur 6 each, Panbari, AIE NH X-ing, Lakhipur, Kampur, Beki Mathanguri, Baghdogra, Ananthapur & Koppal 5 each, Jalpaiguri, Kolkata, Galgalia, Kakrapar, Dharampur & Kolar Gold Field 4 each, Ranchi, Vapi & Silvasa 3 each	Gopalpur 6, Kalingapatnam 5, Thiruvananthapuram 2, Nancowry & Chennai 1 each	-
11.	Malegaon 29, Midnapore 11, Dhubri 10, Nizamabad & Sriramsagar 9 each, Barsi, Jalgaon, Tirupattur & Chintamani 7 each, Prathipadu & Punganur 6 each, Port Blair, Kampur, NH X-ing, Surat, Yeotmal, Mangrulpir, Chandrapur, Chintapalli, Bheemgal, Allagadda, Siddalaghatta, Haluwa & Enamanchel 5 each, Beki Mathanguri, Mount Abu, Deesa, Sholapur, Parbhani, Pusad, Gudur, Kollapur, Ramgundam, Srisailam, Chittoor & Pawagad 4 each, Chargharia, Mahabaleshwar, Nanded, Visakhapatnam, Bidar, Bangalore & Kottayam 3 each	Visakhapatnam 8, Paradip 6, Waltair 5, Digha 2	-
12.	Gangtok 13, Tenali 10, Kundapura 7, Port Blair, Hayaghat, Guntur, Udupi, Basaralu & Magadi 5 each, Chintalapudi & Koderu 4 each, Japla, Mahabaleshwar, Bapatla, Visakhapatnam, Nandyal, Kota, Agumbe & Mangalore 3 each	Puri & Kalingapatnam 7 each, Gopalpur & Waltair 6 each, Agartala & Tiruchirapalli 3 each, Konni 2, Car Nicobar 1	Hadan Taj & Mop 3 each, Sonmarg 2, Banihal, Niru, Zamidarkhan Galli & Quazigund 1 each
13.	Narsapur & Thiruvananthapuram 6 each, Arogyavaram, Sulurpet, Gadag, Annegeri, Bayadgi & Thuruvekere 5 each, Malda, Visnagar & Vijapur 4 each, Gudur, Kollur, Ankola & Siruguppa 3 each	Kondul 4, Digha & Paradip 3 each, Balasore 2, Bhubaneswar 1	-
14.	Kochi 17, Kodungallur & Alapuzha 14 each, Amraghat 8, Chintamani 6, Kailashshahar, Alagadda & Koppal 5 each, Chouldhowaghat, Kavali, Gooty, Penukonda & Jamakhandi 4 each, Dholai, Balasore, Sattenapalli, Kurnool, Vedaranniyam, Karwar & Bellary 3 each	Nancowry 7, Kondul 2, Gopalpur, Paradip & Nagapattinam 1 each	Pahalgam 2, Hut Bay & Srinagar 1 each
15.	Kayamkulam 13, Alapuzha, 9, Uppinangaddy 7, Mandya 6, Agartala & Karaikal 5 each, Jalgaon 4, Sulurpet, Puttur & Minicoy 3 each	K. Paramathy 7, Kanjirapally 6, Waltair, Coimbatore & Konni 5 each, Tuni 4, Gopalpur 2, Kondul 1	Bhuntar 2, Quazi Gund 1
16.	Sulurpet 26, Nellore 25, Tirupathi 15, Chennai 10, Kollam 9, Tiruttani & Kannur 8 each, Gopalpur 7, Lakhipur, Koida & Mangalore 5 each, Nancowry & Kailashahar 4 each	Vythiri 7, Chalakudy & Taliparamba 6 each, Mudibidre 5, Karkala 4, Coimbatore & Madapura 3 each, Chandrapur 2, Kondul & Bapatla 1 each	Bhuntar 3, Nancowry & Shimla 2 each, Car Nicobar, Port Blair, Patiala & Sundernagar 1 each
17.	Badvel 23, Nandyal & Kurnool 15 each, Gopalpur 7, Anantpur & Chintamani 6 each, Tirupathi & Madhugiri 5 each, Agartala & Kozha 4 each, Maya Bandar & Paradip 3 each	Aryankavu 11, Thirthala 8, Nagapattinam 7, Jagdalpur, Uppinangady, Belthangady & Chickmagalur 6 each, Adirampattinam 5, Pune & Belgaum 4 each, Nancowry 3, Minicoy 2	-
18.	Midnapore 11, Paradip 7, Dhubri 6, Agartala 5, Balasore, Jeewargi & Thodupuzha 4 each, Bellary 2	Tirupathi & Cuddalore 3 each, Karaikal 2, Tezpur 1	Kondul 5, Chennai 4, Pamban & Vedaranniyam 3 each, Karaikal, Nagapattinam, Cuddalore & Vellore 2 each
19.	Phulbani 6, Cuttack 4, Madurai 3, Maya Bandar & Gannavaram 2 each, Mahabubnagar & Thiruvananthapuram 1 each	Nancowry 6, Kondul 5, Coimbatore 4, Kochi & Kottayam 3 each, Arogyavaram & Mangalore 1 each	Car Nicobar 9, Nancowry 6, Kondul 5, Bhuntar, Batote & Thiruvananthapuram 2 each, Kodaikanal 1
20.	Coimbatore 15, Bandipura 10, Periyakulam 8, Malavalli 7, Port Blair 5, Kakinada 3, Tirupathi 2, Kochi 1	Nancowry 5, Agartala 2, Nagapattinam & Karaikal 2 each, Cuttack 1	Nancowry 6, Kondul 2
21.	Tuni 4, Port Blair, Maya Bandar, Mahabubnagar, Pamban & Devadurga 3 each, Manchikeri, Kalasa & Idukki 2 each	Chennai, Cuddalore, Nagapattinam & Karaikal 2 each, Kondul & Minicoy 1 each	Chennai 10, Adirampattinam 8, Pamban & Vedaranniyam 6 each, Karaikal & Nagapattinam 4 each, Nellore 1
22.	Kanyakumari 5, Palayamkottai & Konni 4 each, Nancowry & Idukki 3 each, Ongole & Murnad 2 each, Krishnanagar 1	Vedaranniyam 8, Nagapattinam 7, Adirampattinam 6, Chennai 5, Guwahati 1	Tirupathi & Chennai 5 each, Vedaranniyam 2, Car Nicobar & Nellore 1 each

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)
23.	Karaikal 8, Nagapattinam 7, Pamban 5, Punalur & Minicoy 1 each	Palayamkottai &Thiruvananthapuram 3 each, Nancowry, Kondul & Vedaranniyam 2 each, Minicoy 1	Vedaranniyam 17, Kavali 8, Chennai 7, Nagapattinam & Palayamkottai 5 each, Nellore 2, Mandya & Amini Divi 1 each
24.	Chennai 4, Gopalpur 3, Maya Bandar & Ongole 2 each	Car Nicobar & Nancowry 3 each	Karaikal 8, Nellore & Nagapattinam 7 each, Nancowry 5, Amini Divi 1
25.	Kondul 8, Mandya 5, Nellore & Karaikal 4 each, Thalaserry & Kochi 3 each, Arogyavaram 2	Guwahati & Amini Divi 1 each	Nagapattinam 8, Karaikal 6, Kodaikanal & Vellore 3 each, Kondul 2, Nellore 1
26.	Kochi 9, Coimbatore 8, Kannara 6, Kondul, Tondi & Alapuzha 5 each	Car Nicobar 5, Nancowry 4, Minicoy 2	Tirupathi & Belgaum 5 each, Karaikal & Pamban 2 each
27.	Kudulu 13, Thiruvananthapuram 10, Pamban 8, Tondi 5, Port Blair & Hut Bay 3 each, Machilipatnam 2, Narsapur & Amini Divi 1 each	Nancowry 5, Kondul & Nagapattinam 3 each, Car Nicobar & Minicoy 2 each, Karaikal 1	Belgaum 2, Ratnagiri & Hidkal 1 each
28.	Maya Bandar 4, Minicoy 3, Port Blair 2, Tuni & Tiruchirapalli 1 each	Paradip & Nellore 1 each	-
29.	Gaya & Madurai 7 each, Kodaikanal 3, Car Nicobar 2	Kondul 5, Car Nicobar 2	Kondul 1
30.	Imphal & Digha 4 each, Car Nicobar & Hut Bay 3 each, Shillong 2, Diamond Harbour 1	Car Nicobar 3, Nancowry 2, Kakinada 1	Nancowry 3
31.	Krishnanagar 5, Guwahati 4, Port Blair 3, Shillong, Agartala & Cooch Behar 2 each	-	Kondul 3

3.3.3. *Monthly rainfall*

Monthly rainfall for the month of December 2001 was *normal* in 4 (Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim, Rayalaseema and Tamil Nadu), deficient in 4 (Andaman & Nicobar Islands, Punjab, Himachal Pradesh and coastal Andhra Pradesh) and *scanty* in 13 (Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, Uttaranchal, Haryana, Jammu & Kashmir, west Rajasthan, Madhya Maharashtra, coastal Karnataka, north interior Karnataka, south interior Karnataka, Kerala and Lakshadweep) meteorological sub-divisions. There was no rain in the remaining 14 (Gangetic West Bengal, Orissa, Jharkhand, Bihar, east Uttar Pradesh, east Rajasthan, west Madhya Pradesh, east Madhya Pradesh & Chattisgarh, Gujarat Region, Saurashtra & Kutch, Konkan & Goa, Marathwada, Vidarbha and Telangana) meteorological sub-divisions. The significant amounts of rainfall (cm) during the month are given in Table 5.

3.3.4. *Temperature*

Cold wave conditions prevailed on 6 days in some parts of east Rajasthan; on 2 days in some parts of west Rajasthan and on 1 day each in some parts of Orissa, Jharkhand, Bihar, Jammu & Kashmir, west Madhya Pradesh, Madhya Maharashtra and Vidarbha. Night temperatures were generally *below to appreciably below normal* over peninsular India in the first fortnight of the month. They were generally either *appreciably to markedly above normal* or *above normal* over the rest of the country almost throughout the month except northeast India.

Month's and season's lowest minimum temperatures in the plains of the country was 0.4^{o} C recorded at Churu (west Rajasthan) on 22 December 2001.

3.3.5. *Disastrous weather events*

According the press reports, severe cold wave took a toll of 51 human lives in north India especially in Bihar and Uttar Pradesh 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 between –19 % to +19 %.

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

Scanty - percentage departure from normal rainfall is between –60 % to –99 %.

Southwest/northeast monsoon activity

Vigorous - mean rainfall more than 4 times the normal with minimum 7 cm along the west coast and 5 cm elsewhere in atleast two stations in the sub-division

Active - mean rainfall more than 1 ½ 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 distribution

At most places - 75 % or more stations of a meteorological sub-division reporting at least 2.5 mms rainfall.

At many places - 51% to 74 % stations of a meteorological sub-division; reporting at least 2.5 mms rainfall.

At a few places - 26 % to 50% stations of a meteorological sub-division reporting at least 2.5 mms rainfall.

At isolated places - 25% or less stations of a meteorological sub-division; reporting at least 2.5 mms rainfall.

Heavy rainfall

Very heavy rainfall - rainfall amount 12.5 cms or more over one or two stations in the sub-division.

Heavy rain rainfall - rainfall amount from 6.5 cms to 12.4 cm over one or two stations in the sub-division.

Temperature (Maximum / Day temperature)

Severe heat wave conditions - departure of maximum temperature from normal is + 5^o C or more for the regions where the normal maximum temperature is more than 40^o C and departure of maximum temperature from normal is +7^o C or more for the regions where the normal maximum temperature is 40^o C or less.

Heat wave conditions - departure of maximum temperature from normal is between + 3^o C to + 4^o C or more for the regions where the normal maximum temperature is more than 40^o C.

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

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

Above normal - departure of maximum temperature from normal is +2^o C.

Normal - departure of maximum temperature from normal is between +1^o C and –1^o C.

Markedly below normal - departure of maximum temperature from normal is between –5^o C or less.

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

Below normal - departure of maximum temperature from normal is –2^o C.

Temperature (Minimum / Night temperature)

Severe cold wave conditions - departure from normal minimum temperature is –5^o C or less for the regions where normal minimum temperature is less than 10^o C and –7^o C or less elsewhere.

Cold wave conditions - departure of minimum temperature from normal is –3^o C to –4^o C where normal minimum temperature is less than 10^o C.

Markedly below normal - departure of minimum temperature from normal is –5^o C to –6^o C for the regions where the normal minimum temperature is 10 ^{o} C or more.

Appreciably below normal - departure of minimum temperature from normal is between –3^o C to –4^o C for the regions where the normal minimum temperature is 10 ^{o} C or more.

Markedly above normal - departure of minimum temperature from normal is +5^o C to +6^o C.

Appreciably above normal - departure of minimum temperature from normal is between +3^o C to +4^o C

[Same criteria for above normal and below normal in case of maximum (day) and minimum (night) temperatures].