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Weather in India

WINTER SEASON (January-February 2009)†

1. Introduction

The winter season of this year, (January & February 2009) was perceived to be exceptionally warm or in other words, the cold season experienced was rather short lived. Barring a short span comprising the first fortnight of January, both the day & night temperatures (represented by the day maximum & night minimum respectively) remained warmer than normal over many parts of the country. The main reasons for this anomaly included the following :

(a) Western disturbances affected only the extreme northern and western parts of the country and did not affect the central and northeast region of India (as is well evident from the seasonal rainfall distribution shown in Fig. 1.

(b) Presence of an anomalous anticyclone (Fig. 2) in the lower layers of the atmosphere over the central parts of the country prevented the onset of northerlies over the region, which brings in cold air advection.

(c) Northward shift of the subtropical Ridge and the persistence of anticyclone, right from the lower levels resulted in subsidence and enhanced warming and

(d) The associated clear skies leading to enhanced insolation and higher day temperatures.

The persistently above normal day temperatures during winter months resulted in substantial discomfort. Also dense fog conditions prevailed in the morning hours over many parts of Indo-Gangetic plains upto the 3rd week of January.

No intense low pressure system formed over the north Indian Ocean during the period. Western disturbances and easterly waves remained to be the main contributors of rainfall and the winter precipitation had been quite subdued.

2. Seasonal rainfall (January-February)

The seasonal sub-divisionwise rainfall (actual, normal and percentage departure) are given in Table 1. The percentage departures falling under various categories

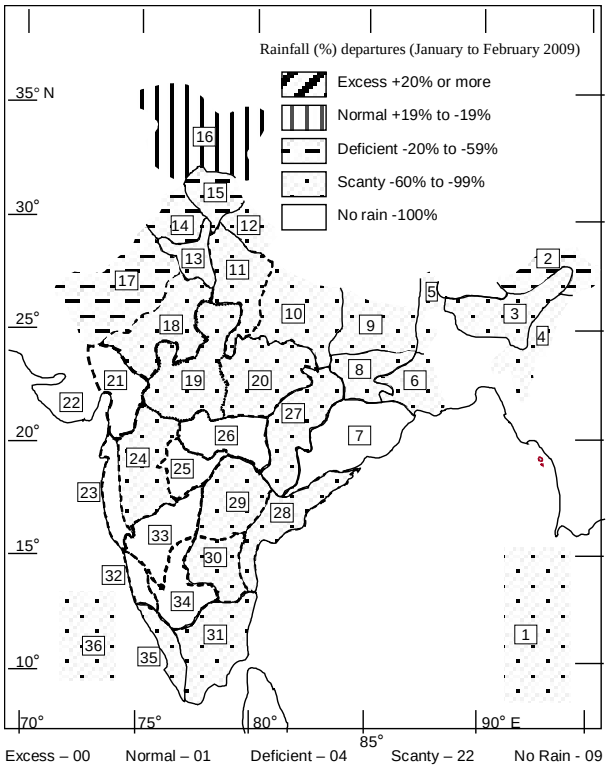

Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for winter season (January to February 2008). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	–75	**7**	–100	**13**	–69	**19**	–70	**25**	–100	**31**	–79
2	–28	**8**	–76	**14**	–46	**20**	–70	**26**	–100	**32**	–100
3	–67	**9**	–91	**15**	–51	**21**	–100	**27**	–95	**33**	–100
4	–87	**10**	–96	**16**	1	**22**	–100	**28**	–97	**34**	–100
5	–92	**11**	–78	**17**	–49	**23**	–100	**29**	–78	**35**	–84
6	–89	**12**	–77	**18**	–98	**24**	–97	**30**	–93	**36**	–83

viz., *excess**, *normal deficient*, *scanty* and no rain are shown in Fig. 1.

Climatologically, the western disturbances moving from west to east, move to northeast India after traveling across the northern states *viz*., Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh and Uttarakhand. These western disturbances on interacting with local circulation features and topography of the region, give rise to precipitation over northwest and northeastern parts of the country during winter season. This year, as stated earlier, the impact of western disturbances remained confined to the extreme northern parts of Jammu & Kashmir. As such

* *Definition of words in italics other than the subtitles is given in Appendix.*

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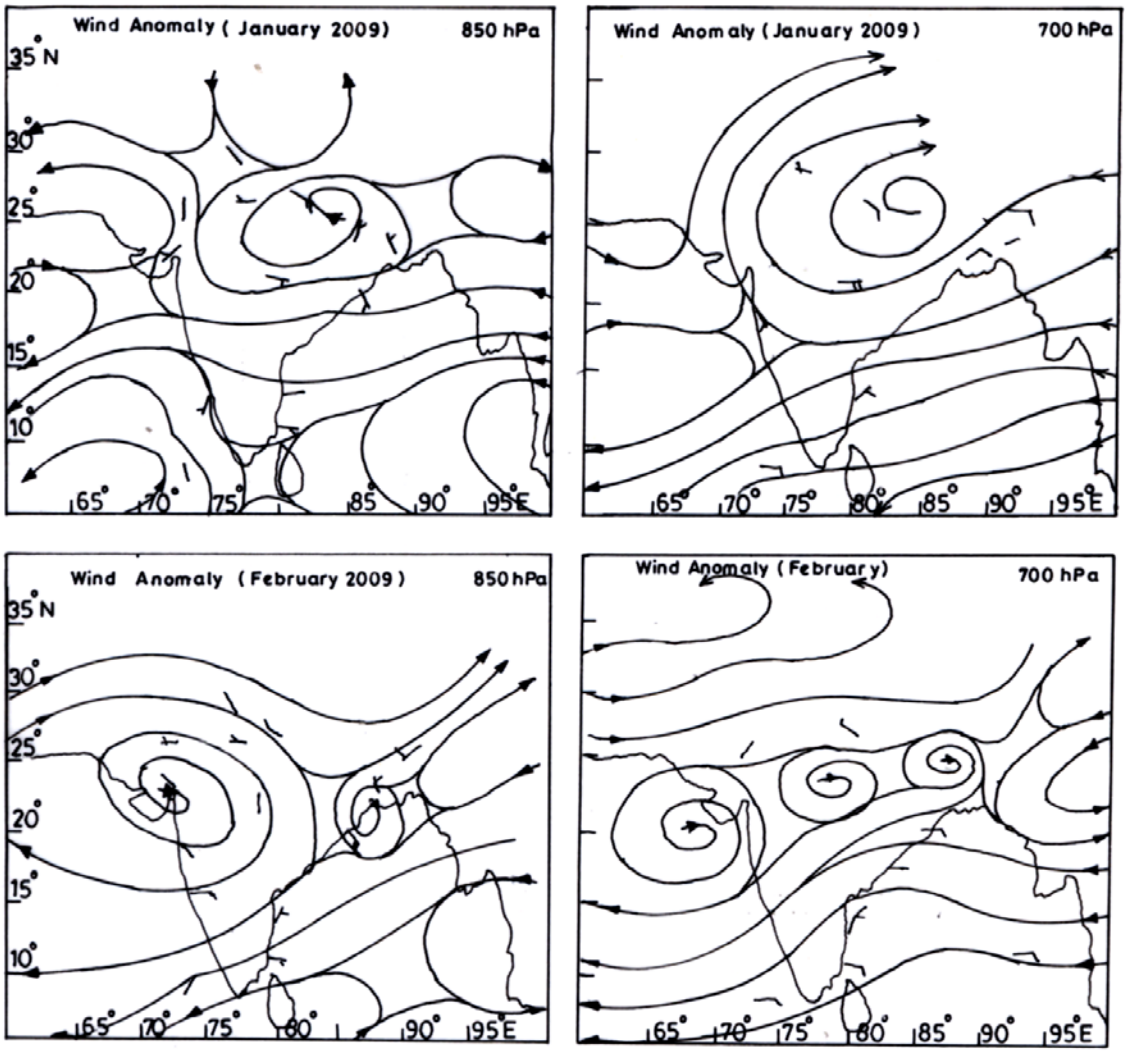

Fig. 2. Lower level wind anomalies for the months January and February 2009

these systems gave rise to precipitation mainly over Jammu & Kashmir, resulting in deficient rainfall situation over the remaining region. The persistence of an anticyclonic circulation right from the lower levels, as mentioned earlier also contributed to the rainfall deficiency over the central parts of the country. The frequency and amplitude of easterly waves also were less and as a result, the southern parts received *scanty* rainfall.

3. Monthly features

3.1. *January*

3.1.1. *Weather and associated synoptic features*

As given in Table 2, there were 14 systems in westerlies (including 4 upper air cyclonic circulations, 8 induced cyclonic circulations and 2 troughs in mid and upper tropospheric levels), 4 upper air cyclonic circulations and 2 troughs in easterlies affecting the weather over the country.

The resultant sub-divisionwise spatial rainfall distribution and frequency of *heavy* and *very heavy* rainfall are given in Table 3.

3.1.2. *Monthly rainfall*

The sub-divisionwise percentage departures of monthly rainfall are given in Table 1. Principal amounts of rainfall during the month of January are given in Table 8.

Moisture incursion and confluence in the wind field gave rise to rainfall over northern and central parts of the country during 8 – 11 January. In general, rain/snow

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (January-February 2009)

S. No.	Meteorological Sub-divisions	January			February			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A. & N. Islands	15	56	-73	6	29	-79	21	85	-75
2.	Arunachal Pradesh	27	49	-45	72	89	-19	99	138	-28
3.	Assam & Meghalaya	4	18	-78	11	27	-59	15	45	-67
4.	Naga., Mani., Mizo. and Tri.	**	14	-99	5	27	-81	5	41	-87
5.	Sub-Himalayan West Bengal & Sikkim	2	19	-91	2	30	-93	4	49	-92
6.	Gangetic West Bengal	2	13	-82	1	19	-95	3	32	-89
7.	Orissa	0	12	-99	0	20	-100	0	32	-99
8.	Jharkhand	9	18	-50	0	20	-100	9	39	-76
9.	Bihar	1	17	-91	1	12	-91	3	28	-91
10.	East Uttar Pradesh	**	19	-99	1	14	-92	1	33	-96
11.	West Uttar Pradesh	3	20	-83	5	16	-71	8	36	-78
12.	Uttaranchal	3	60	-94	23	56	-59	27	116	-77
13.	Haryana, Chandigarh & Delhi	4	20	-79	7	16	-55	11	36	-69
14.	Punjab	10	27	-62	17	24	-28	27	51	-46
15.	Himachal Pradesh	49	100	-51	45	92	-51	94	192	-51
16.	Jammu & Kashmir	121	106	15	116	128	-10	237	234	1
17.	West Rajasthan	1	4	-62	3	4	-36	4	8	-48
18.	East Rajasthan	**	6	-98	0	5	-99	**	11	-98
19.	West Madhya Pradesh	5	11	-55	0	6	-99	5	17	-70
20.	East Madhya Pradesh	13	26	-49	**	19	-99	13	45	-70
21.	Gujarat region	0	1	-100	0	1	-100	0	2	-100
22.	Saurashtra & Kutch	0	1	-100	0	1	-100	0	2	-100
23.	Konkan & Goa	0	1	-100	0	**	-100	0	1	-100
24.	Madhya Maharashtra	**	2	-96	0	1	-100	**	4	-97
25.	Marathawada	0	3	-100	0	3	-100	0	7	-100
26.	Vidarbha	0	11	-100	0	11	-100	0	22	-100
27.	Chattisgarh	1	13	-90	0	14	-100	1	27	-95
28.	Coastal Andhra Pradesh	**	7	-94	0	9	-100	**	15	-97
29.	Telangana	2	4	-51	0	6	-100	2	10	-79
30.	Rayalaseema	1	3	-87	0	3	-100	1	7	-93
31.	Tamil Nadu	7	21	-64	0	14	-99	7	35	-79
32.	Coastal Karnataka	0	2	-100	0	**	-100	0	2	-100
33.	North interior Karnataka	0	2	-100	0	3	-100	0	5	-100
34.	South interior Karnataka	0	2	-98	0	3	-100	0	5	-99
35.	Kerala	3	11	-71	1	17	-92	5	28	-84
36.	Lakshadweep	5	20	-77	1	17	-92	6	37	-83
	All India country as a whole	12	20.8	43	12	23	-48	24	43.8	-45

** Indicates rainfall amounts 0.1 to 0.4 mm, (amounts less than 0.1 mm are rounded off to zero).

TABLE 2

Details of the weather systems during January 2009

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Place of final location (6)	Remarks (7)
(**A**)	*Western disturbances/ eastward moving systems*					
(*i*)	*Upper air cyclonic circulations*					
1.	Upto mid tropospheric levels	2-5	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 6
2.	Do	7-12	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 13
3.	Upto lower tropospheric levels	12-19	North Pakistan and neighbourhood	Do	Do	Moved away on 20
4.	Upto mid tropospheric levels	22-27	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 28
(*ii*)	*Induced upper air cyclonic circulations*					
1.	Upto lower tropospheric levels	4-7	Punjab & neighbourhood	Northeast	Uttarakhand & neighbourhood	Moved away on 8
2.	Do	7-9	Central Pakistan and adjoining Punjab	Do	Punjab and adjoining Haryana	Less marked on 10
3.	Between 3.1 & 5.8 kms a.s.l.	10-13	Punjab & neighbourhood	Do	Uttarakhand and neighbourhood	Moved away on 14
4	Upto lower tropospheric levels	14-18	Central Pakistan and adjoining west Rajasthan	Do	East Rajasthan and neighbourhood	Moved away on 19
5.	Upto mid tropospheric levels	15-16	Punjab and neighbourhood	Stationary	In situ	Less marked on 17
6.	Upto 0.9 km a.s.l.	17-18	East Uttar Pradesh	Northeast	Do	Moved away on 19
7.	Upto 1.5 kms a.s.l.	19-20	Punjab and neighbourhood	Stationary	Do	Less marked on 21
8.	Do	22-27	Northwest Rajasthan and neighbourhood	Stationary	*In Situ*	Less marked on 28
(*iii*)	*Troughs in westerlies*					
1.	Upto mid & upper tropospheric levels	15-18	Northeast Afghanistan to Saudi Arabia	Northeast	Along Long. 65.0° E to the north of Lat. 20.0° N at 7.6 km a.s.l.	Moved away on 19
2	Do	29	Along Long. 65.0° E to the north of Lat. 20.0° N at 5.8 km a.s.l.	Northeast	-	Moved away on 30
(**B**)	*Other cyclonic circulations*					
1.	Upto lower tropospheric levels	3-8	South Tamil Nadu and neighbourhood	West	Lakshadweep and neighbourhood	Less marked on 9
2.	Do	6-7	East Madhya Pradesh and neighbourhood	East	Chattisgarh and neighbourhood	Less marked on 8
3	Do	8-13	East central Arabian sea and adjoining north Maharashtra-south Gujarat coasts	Northeast	North Maharashtra and adjoining Gujarat region	Less marked on 14
4.	Do	28-29	South Tamil Nadu and adjoining south Kerala	Stationary	*In situ*	Less marked on 30
(**C**)	*Troughs in easterlies*					
1.	At sea level	7-12	South Andaman sea and adjoining southeast Bay of Bengal	West	Southwest Bay off Tamil Nadu-Sri Lanka coasts	Less marked on 13
2.	Do	19-29	South Andaman sea	Do	Southwest Bay and adjoining Sri-Lanka	Less marked on 30

TABLE 3

Rainfall distribution for the month of January 2009

S. No.	Sub–division	VHR	HR	W	Fw	Sc	Iso	Dry
1.	Andaman & Nicobar Islands	-	1	-	-	1	5	25
2.	Arunachal Pradesh	-	-	-	-	3	3	25
3.	Assam & Meghalaya	-	-	-	-	-	5	26
4.	Naga. Mani. Mizo. & Trip.	-	-	-	-	-	-	31
5.	Sub–Himalayan W. B. & Sikkim	-	-	-	-	-	1	30
6.	Gangetic West Bengal	-	-	-	-	-	1	30
7.	Orissa	-	-	-	-	-	-	31
8.	Jharkhand	-	-	-	-	1	2	28
9.	Bihar	-	-	-	-	-	-	31
10.	East Uttar Pradesh	-	-	-	-	-	1	30
11.	West Uttar Pradesh	-	-	-	-	-	1	30
12.	Uttarakhand	-	-	-	-	-	1	30
13.	Haryana, Chandigarh & Delhi	-	-	-	1	-	5	25
14.	Punjab	-	-	-	2	1	4	24
15.	Himachal Pradesh	-	1	1	3	2	7	18
16.	Jammu & Kashmir	-	-	4	5	3	1	18
17.	West Rajasthan	-	-	-	-	2	-	29
18.	East Rajasthan	-	-	-	-	-	1	30
19.	West Madhya Pradesh	-	-	-	-	1	3	27
20.	East Madhya Pradesh	-	-	-	1	3	2	25
21.	Gujarat Region	-	-	-	-	-	-	31
22.	Saurashtra & Kutch	-	-	-	-	-	-	31
23.	Konkan & Goa	-	-	-	-	-	-	31
24.	Madhya Maharashtra	-	-	-	-	-	1	30
25.	Marathwada	-	-	-	-	-	-	31
26.	Vidarbha	-	-	-	-	-	-	31
27.	Chattisgarh	-	-	-	-	2	1	28
28.	Coastal Andhra Pradesh	-	-	-	-	-	-	31
29.	Telangana	-	-	-	-	-	-	31
30.	Rayalaseema	-	-	-	-	-	-	31
31.	Tamil Nadu & Puducherry	-	1	-	-	1	7	23
32.	Coastal Karnataka	-	-	-	-	-	-	31
33.	North interior Karnataka	-	-	-	-	-	-	31
34.	South interior Karnataka	-	-	-	-	-	-	31
35.	Kerala	-	-	-	1	-	2	28
36.	Lakshadweep	-	-	-	-	-	2	29

TABLE 4

Dates of occurrence of cold wave/severe cold wave and various categories of minimum temperatures - January 2009

Sub-division S. No.	Name	Dates (Number of days)						
		Severe cold wave	Cold wave	Cold day	Appreciably to markedly below normal	Below normal	Appreciably to markedly above normal	Above normal
2.	Arunachal Pradesh	Nil	Nil	Nil	Nil	Nil	26-28 (3)	Nil
3.	Assam & Meghalaya	Nil	Nil	Nil	1, 4, 9 (3)	3, 8, 10, 11 (4)	5-7, 14-30, (20)	2, 13, 31 (3)
4.	Naga., Mani, Mizo and Tri.	Nil	Nil	Nil	29 (1)	Nil	9, 12-14, 19, 21, 23-29 (13)	2, 4, 11, 19, 20, 22, 30 (7)
5.	S. H. W. B. & Sikkim	Nil	Nil	Nil	Nil	Nil	9-11, 14, 16-31 (20)	4, 7, 13 (3)
6.	Gangetic West Bengal	Nil	Nil	Nil	Nil	Nil	6-12, 20, 24-29 (14)	1, 13, 17, 19 (4)
7.	Orissa	Nil	Nil	Nil	Nil	Nil	2, 6, 7, 10-13, 15, 26-31 (14)	1, 3-6, 13, 19, 20, 22, 24, 25, 30 (12)
8.	Jharkhand	Nil	Nil	Nil	2-6, 16, 17 (6)	1, 21-25, 30 (7)	7-13, 26, 27, 29 (10)	13, 14, 19, 20, 28 (5)
9.	Bihar	Nil	Nil	4 (1)	3-5 (3)	1, 2, 30 (3)	6, 7, 9-11, 18, 19, 20, 26, 27 (10)	12, 21, 23, 24, 28 (5)
10.	East Uttar Pradesh	Nil	2, 4, 6 (3)	3-5 (3)	2-6, 13 (6)	1, 15 (2)	7, 9-11, 16, 18-20, 25-28 (12)	12, 14, 15, 23, 28, 29 (6)
11.	West Uttar Pradesh	Nil	2 (1)	1, 4, 5 (3)	2 (1)	Nil	9-11, 13, 16-20, 24-27 (13)	12, 13, 23, 28(4)
12.	Uttarakhand	Nil	Nil	Nil	Nil	1, 6, 8 (3)	4, 7, 13, 16, 17, 20, 22-27, 30, 31 (14)	11, 19, 28, 29(4)
13.	Haryana, Chandigarh & Delhi	Nil	Nil	1-4 (4)	1, 2, 8, 9 (4)	3, 6, 12, 13, 30 (5)	10, 15-20, 22-28, 31 (15)	4, 11, 15, 21, 29 (5)
14.	Punjab	Nil	9 (1)	2-5 (4)	2, 13 (2)	1, 3, 7, 8, 11, 30 (6)	16-19, 24-26 (7)	4, 15 (2)
15.	Himachal Pradesh	Nil	Nil	6 (1)	15 (1)	Nil	13, 14, 16-18, 20-27, 30, 31 (15)	2, 11, 12 (3)
16.	Jammu & Kashmir	Nil	Nil	6 (1)	1, 2 (2)	15, 27 (2)	3, 7, 11, 17, 24-28, 30 (10)	4, 22, 29 (3)
17.	West Rajasthan	Nil	Nil	Nil	Nil	6, 9, 12, 13 (4)	1-5, 10, 12-27, 29-31 (25)	11, 28 (2)
18.	East Rajasthan	Nil	Nil	Nil	1 (1)	9, 12, 13 (3)	2, 4, 8, 10, 12-31 (24)	6, 7, 11 (3)
19.	West Madhya Pradesh	Nil	Nil	Nil	28 (1)	1, 13 (2)	8-12, 14-21, 24-27, 29-31 (20)	4, 7, 19, 22, 28, 29 (6)
20.	East Madhya Pradesh	Nil	Nil	Nil	Nil	1,13. (2)	6, 7, 9-12, 14-20, 24-28, 30, 31 (20)	4-6, 19, 21, 22, 29 (7)
21.	Gujarat Region	Nil	Nil	Nil	28 (1)	6, 13, 27, 28 (4)	5, 10-12, 14-26 (17)	2-4, 9, 27, 29, 30 (7)
22.	Saurashtra & Kutch	Nil	Nil	Nil	28 (1)	1, 13, 31 (3)	1, 4-8, 11, 12, 14-26, 29 (22)	3, 6, 10, 27, 28, 30 (6)
23.	Konkan & Goa	Nil	Nil	Nil	1, 7 (2)	2, 5, 7 (3)	14, 15, 17, 23, 24, 28-31 (9)	4, 11-13, 16, 19, 25 (7)

TABLE 4 (*Contd.*)

Sub-division S. No.	Name	Dates (Number of days) Severe cold wave	Cold wave	Cold day	Appreciably to markedly below normal	Below normal	Appreciably to markedly above normal	Above normal
24.	Madhya Maharashtra	Nil	Nil	Nil	1, 23 (2)	1, 13 (2)	9-12, 14-16, 25, 28-31 (12)	3-5, 8, 10, 11, 13, 16-18, 20-22, 23, 25, 26 (16)
25.	Marathwada	Nil	Nil	Nil	Nil	2 (1)	6, 8-13, 15, 16, 18-21, 24-28, 30, 31 (20)	23 (1)
26.	Vidarbha	Nil	Nil	Nil	4, 18, 24 (3)	1-3, 23, 25 (5)	5-16, 26, 27, 29-31 (17)	15, 17, 20, 28 (4)
27.	Chattisgarh	Nil	Nil	Nil	Nil	21 (1)	5-16, 27-31 (17)	20, 26 (2)
28.	Coastal Andhra Pradesh	Nil	Nil	Nil	Nil	15, 16, 19-21, 27, 28 (7)	3, 8-10, 31 (5)	2-5, 11, 13, 14, 18, 30 (8)
29.	Telangana	Nil	Nil	Nil	23, 24, 28 (3)	16, 18, 19 (3)	6, 7, 8, 9, 10, 11, 12, 31 (8)	3, 5, 13, 27, 30 (5)
30.	Rayalaseema	Nil	Nil	Nil	5, 18-20, 24-28, 30, 31 (11)	2, 7, 15, 16, 19, 21(6)	14, 31 (2)	8 (1)
31.	Tamil Nadu	Nil	Nil	Nil	1, 4, 21, 24 (4)	1, 5, 6, 13, 17, 18, 20, 22, 25, 31 (10)	14, 28, 29 (3)	8, 10, 16, 27, 28, 30 (6)
32.	Coastal Karnataka	Nil	Nil	Nil	25 (1)	1, 6, 20, 23, 24, 26 (6)	30 (1)	10, 11, 15-17 (5)
33.	North Interior Karnataka	Nil	Nil	Nil	4, 13, 16, 18-21, 23-27, 30 (13)	15, 19, 20, 22 (4)	Nil	9, 11 (2)
34.	South Interior Karnataka	Nil	Nil	Nil	2, 4, 7, 17, 18, 20, 23-27, 30, 31 (13)	1, 5, 6, 13, 15, 17, 19-22 (10)	14, 27 (2)	9-11 (3)
35.	Kerala	Nil	Nil	Nil	1, 5, 18, 20, 24, 30 (6)	1-3, 6, 15, 16, 21, 26, 30 (9)	14 (1)	28, 29 (2)

occurred over the northwestern states due to passage of western disturbances. Also easterly waves caused rainfall over the south peninsula for a few days.

3.1.3. *Temperature*

January, generally one of the coldest months in the country, proved to be unusually warm this year. Abnormally hot conditions prevailed in the second fortnight of the month, which impacted northern and central India. After 22 January, a number of places recorded higher than normal maximum temperatures, some of them going as high as 13° C above normal as recorded at Mukteswar in Uttarakhand on 27 January.

The dates of occurrence of *cold waves* and dates on which the minimum temperature remained *appreciably to markedly above/below normal* as well as *above/below normal* are given in Table 4. Same date appearing in two different columns of sub-divisions may be reckoned as occurrence of that category over parts of the sub-divisions. Minimum temperatures were normal for the rest of the days.

The month's and the season's lowest minimum temperature over the plains was 1° C recorded at Amritsar (Punjab) on 1 & 2 January 2009.

3.1.4. *Disastrous weather events and damage*

Cold wave claimed 36 lives in Uttar Pradesh and 11 in Punjab during the first fortnight of January. A large number of domestic and international flights were affected due to fog at the Indira Gandhi International Airport, New Delhi. Also fog disrupted all means of transport over the northwestern parts of the country.

TABLE 5

Details of the weather systems during February 2009

S. No. (1)	System (2)	Duration (3)	Place of first location (4)	Direction of movement (5)	Place of final location (6)	Remarks (7)
(**A**)	*Western disturbances/eastward moving systems*					
(*i*)	*Upper air cyclonic circulations*					
1.	Upto Mid tropospheric levels	1-6	North Pakistan and adjoining Jammu & Kashmir	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 7
2.	Do	8-10	Do	Do	Do	Moved away on 11
3.	Do	12-14	Do	Do	Do	Moved away on 15
4.	Do	15-17	Do	Do	Do	Moved away on 18
5.	Do	18-21	North Pakistan and neighbourhood	Do	Do	Moved away on 22
6.	Do	22	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 23
7.	Do	24-25	Do	Do	Do	Moved away on 26
(*ii*)	*Induced cyclonic circulations*					
1.	Upto lower tropospheric levels	4-7	West Rajasthan and neighbourhood	Northeast	Uttarakhand and neighbourhood	Less marked on 8
2.	Do	9-15	Central Pakistan and adjoining west Rajasthan	Do	Haryana and neighbourhood	Moved away on 16
3.	Do	14-17	Central Pakistan and adjoining Punjab	Do	Haryana and adjoining Uttarakhand	Moved away on 18
4.	Do	20-21	Punjab and neighbourhood	Stationary	*In Situ*	Less marked on 22
(*iii*)	*Troughs in the westerlies*					
1.	Upto mid & upper tropospheric levels	9-12	Along Long. 60.0° E to the north of Lat. 20.0° N at 5.8 kms a.s.l.	Northeast	Along Long. 88.0° E to the north of Lat. 20.0° N	Moved away on 13
2.	Do	13-14	Along Long. 63.0° E to the north of Lat. 20.0° N at 5.8 kms a.s.l.	Do	Along Long. 68.0° E to the north of Lat. 20.0° N	Moved away on 15
3.	Upto 0.9 km a.s.l.	12	Sub-Himalayan West Bengal & Sikkim to south Chattisgarh	Stationary	*In Situ*	Less marked on 13
4.	Upto lower level	25-31	Arunachal Pradesh to north Bay of Bengal	Oscillatory	Gangetic West Bengal	Less marked on 1 March
(**B**)	*Other cyclonic circulations*					
1.	Between 1.5 & 3.1 kms a.s.l.	30 Jan - 2 Feb	Assam & Meghalaya and neighbourhood	Stationary	*In Situ*	Less marked on 3
2	Upto lower tropospheric levels	26 Feb - 1 Mar	South Tamil Nadu and adjoining Kerala	Do	Do	Less marked on 2 March
(**C**)	*Trough in the easterlies*					
1.	At sea level	31 Jan - 4 Feb	South Andaman sea and neighbourhood	Quasi Stationary	*In situ*	Less marked on 5
2.	Do	9-11	South Andaman sea and adjoining southeast Bay of Bengal	West	Southeast and adjoining southwest Bay of Bengal	Less marked on 12
3.	Do	12-14	South Andaman sea and neighbourhood	Do	Southeast Bay of Bengal	Less marked on 15
4.	Do	24-27	South Andaman sea and adjoining southeast Bay of Bengal	Do	Southeast Bay of Bengal and neighbourhood	Less marked on 28

TABLE 6

Rainfall distribution for the month of February 2009

S. No.	Sub–division	VHR	HR	W	Fw	Sc	Iso	Dry
1.	Andaman & Nicobar Islands	-	-	-	-	1	2	25
2.	Arunachal Pradesh	-	-	1	1	3	7	16
3.	Assam & Meghalaya	-	1	-	-	2	5	21
4.	Naga. Mani. Mizo. & Tripura	-	-	-	-	1	2	25
5.	Sub-Himalayan W. B. & Sikkim	-	-	-	-	-	2	26
6.	Gangetic West Bengal	-	-	-	-	-	1	27
7.	Orissa	-	-	-	-	-	-	28
8.	Jharkhand	-	-	-	-	-	-	28
9.	Bihar	-	-	-	-	-	-	28
10.	East Uttar Pradesh	-	-	-	-	1	-	27
11.	West Uttar Pradesh	-	-	-	-	1	-	27
12.	Uttarakhand	-	-	2	-	-	-	26
13.	Haryana Chnd. & Delhi	-	-	1	-	-	2	25
14.	Punjab	-	-	1	1	1	6	19
15.	Himachal Pradesh	-	1	1	1	3	9	14
16.	Jammu & Kashmir	-	2	3	3	2	8	12
17.	West Rajasthan	-	-	-	-	-	2	26
18.	East Rajasthan	-	-	-	-	-	1	27
19.	West Madhya Pradesh	-	-	-	-	-	1	27
20.	East Madhya Pradesh	-	-	-	-	-	1	27
21.	Gujarat Region	-	-	-	-	-	-	28
22.	Saurashtra & Kutch	-	-	-	-	-	-	28
23.	Konkan & Goa	-	-	-	-	-	-	28
24.	Madhya Maharashtra	-	-	-	-	-	-	28
25.	Marathwada	-	-	-	-	-	-	28
26.	Vidarbha	-	-	-	-	-	-	28
27.	Chattisgarh	-	-	-	-	-	-	28
28.	Coastal Andhra Pradesh	-	-	-	-	-	-	28
29.	Telangana	-	-	-	-	-	-	28
30.	Rayalaseema	-	-	-	-	-	-	28
31.	Tamil Nadu & Puduchhery	-	-	-	-	-	-	28
32.	Coastal Karnataka	-	-	-	-	-	-	28
33.	North interior Karnataka	-	-	-	-	-	-	28
34.	South interior Karnataka	-	-	-	-	-	-	28
35.	Kerala	-	-	-	-	-	3	25
36.	Lakshadweep	-	-	-	-	-	1	27

TABLE 7

Dates of occurrence of cold wave/severe cold wave and various categories of minimum temperatures - February 2009

Sub-division		Dates (Number of days)						
S. No.	Name	Severe cold wave	Cold wave	Cold day	Appreciably to markedly below normal	Below normal	Appreciably to markedly above normal	Above normal
2.	Arunachal Pradesh	Nil	Nil	Nil	Nil	28 (1)	9, 16, 18, 21 (4)	7, 11 (2)
3.	Assam & Meghalaya	Nil	Nil	Nil	Nil	5 (1)	1, 2, 5, 9-13, 15-17, 19, 21-27 (19)	1, 3, 6, 7, 19, 20, 28 (7)
4.	Naga., Mani, Mizo and Tri.	Nil	Nil	Nil	Nil	2, 3, 4 (3)	8, 23, 24, 26-28 (6)	6, 8, 11, 12, 19 (5)
5.	S. H. W. B. & Sikkim	Nil	Nil	Nil	Nil	2, 28 (2)	2, 3, 6-11, 13-16, 18, 22-25, 27 (18)	1, 12, 17-21, 26 (8)
6.	Gangetic West Bengal	Nil	Nil	Nil	18 (1)	19 (1)	7, 11, 12, 23, 25-28 (8)	1, 2 (2)
7.	Orissa	Nil	Nil	Nil	Nil	Nil	1-7, 9-14, 19, 23-28 (20)	4, 13, 15-17, 19-21 (8)
8.	Jharkhand	Nil	Nil	Nil	20 (1)	3-5, 10, 15 (5)	7, 11, 12, 14, 23, 25, 26, 28 (8)	22 (1)
9.	Bihar	Nil	Nil	Nil	Nil	1-4, 10, 14, 19, 20 (8)	8, 12, 16, 22, 23, 27, 28 (7)	21 (1)
10.	East Uttar Pradesh	Nil	Nil	Nil	20 (1)	1-3, 5, 6, 10, 17 (7)	7, 11, 15, 23-28 (9)	8, 13, 21, 22, 24 (5)
11.	West Uttar Pradesh	Nil	Nil	Nil	Nil	2, 3, 17 (3)	5-7, 10, 11, 15, 18, 23-25, 27, 28 (12)	9, 13, 21, 22 (4)
12.	Uttarakhand	Nil	Nil	Nil	Nil	28 (1)	6-10, 17, 20 (6)	3, 4, 15, 17, 19, 24 (6)
13.	Haryana, Chandigarh & Delhi	Nil	Nil	Nil	Nil	2, 3, 9, 16, 17, 27, 28 (7)	5-7, 14, 20-25 (10)	15, 19, 28 (3)
14.	Punjab	Nil	Nil	Nil	Nil	17, 27, 28 (3)	5, 14, 21, 23, 24, 26 (6)	25 (1)
15.	Himachal Pradesh	Nil	Nil	Nil	7, 11, 20 (3)	15, 23 (2)	1-6, 8-10, 13, 14, 16-24 (20)	15 (1)
16.	Jammu & Kashmir	Nil	Nil	Nil	Nil	8, 27, 28 (3)	3, 5, 10, 12-14, 16, 17, 19, 23, 24 (11)	2, 9, 22 (3)
17.	West Rajasthan	Nil	Nil	Nil	Nil	Nil	1-7, 9, 10, 12-14, 18-28 (23)	2, 8, 15, 17 (4)
18.	East Rajasthan	Nil	Nil	Nil	Nil	Nil	2, 3, 5-7, 9, 10, 13-15, 18-28 (21)	2, 4, 8, 11, 12, 14, 16, 17 (8)
19.	West Madhya Pradesh	Nil	Nil	Nil	13 (1)	1 (1)	4-11, 15, 17, 19-22, 25-28 (18)	1, 2, 8, 14-17, 20, 21 (9)
20.	East Madhya Pradesh	Nil	Nil	Nil	Nil	1-3, 12 (4)	4-9, 11, 15, 17, 18, 20-22, 24, 26-28 (17)	1, 8, 10, 14-17, 19-21 (10)
21.	Gujarat Region	Nil	Nil	Nil	Nil	Nil	3, 6, 8, 14-21, 23-28 (17)	1-7, 9, 13, 20 (10)
22.	Saurashtra & Kutch	Nil	Nil	Nil	Nil	1 (1)	3-8, 13-15, 18, 20, 21, 23-28 (18)	3, 6, 7, 17, 19, 20 (6)
23.	Konkan & Goa	Nil	Nil	Nil	12 (1)	2, 3, 5, 11, 13-15 (7)	17, 20, 22 (3)	1, 2, 9, 21, 27, 28 (6)
24.	Madhya Maharashtra	Nil	Nil	Nil	6-8, 13, 15 (5)	3, 5, 12, 15 (4)	1, 8-10, 17, 18, 20-24, 27 (12)	2, 3, 10, 16, 19, 21, 24, 26, 28 (9)
25.	Marathawada	Nil	Nil	Nil	Nil	12, 13 (2)	1, 3, 4, 6-11, 14-25, 27, 28 (23)	2 (1)
26.	Vidarbha	Nil	Nil	Nil	12 (1)	12, 13, 25 (3)	5, 6, 9-11, 15-24, 27, 28 (17)	1, 2, 27 (3)

TABLE 7 (*Contd.*)

Sub-division		Dates (Number of days)						
S. No.	Name	Severe cold wave	Cold wave	Cold day	Appreciably to markedly below normal	Below normal	Appreciably to markedly above normal	Above normal
27.	Chattisgarh	Nil	Nil	Nil	14 (1)	14, 15 (2)	1, 5- 9, 11, 17, 23, 24, 27 (11)	2, 4, 11, 12, 16, 19 (6)
28.	Coastal Andhra Pradesh	Nil	Nil	Nil	Nil	22, 28 (2)	1-5, 26-28 (8)	2, 3, 6-8, 24, 28 (7)
29.	Telangana	Nil	Nil	Nil	Nil	Nil	2-7, 10, 11, 14, 15, 19, 23, 24, 27 (14)	1, 6, 8, 13, 16, 17, 20, 22, 28 (9)
30.	Rayalaseema	Nil	Nil	Nil	2, 11, 18, 20-22 (6)	1, 8, 9, 16, 17, 19, 23, 24 (8)	14 (1)	9 (1)
31.	Tamil Nadu	Nil	Nil	Nil	1, 2, 7, 11, 14-16 (7)	1-3, 5-10, 12, 13, 17, 18, 20 (14)	23 (1)	21, 22, 24, 26, 27 (5)
32.	Coastal Karnataka	Nil	Nil	Nil	Nil	15, 19 (2)	3, 23, 27, 28 (4)	2, 4, 14, 24, 26 (5)
33.	North Interior Karnataka	Nil	Nil	Nil	15, 20-22 (4)	2, 12-14, 17, 24, 28 (7)	Nil	6-9 (4)
34.	South Interior Karnataka	Nil	Nil	Nil	7, 8, 11, 14, 18, 19-21 (8)	5, 6, 9, 12, 13, 15-17 (8)	2, 23, 28 (3)	22, 24-26 (4)
35.	Kerala	Nil	Nil	Nil	1, 2, 11, 20 (4)	1, 3, 4, 6, 10, 17, 19 (7)	23, 26-28 (4)	22, 24, 27 (3)

3.2. *February*

3.2.1. *Weather and associated synoptic features*

As is seen from Table 5, there were 15 western disturbances (including 7 upper air cyclonic circulations, 4 induced cyclonic circulations and 4 troughs in westerlies), upper air cyclonic circulations and 4 troughs in the easterlies which affected the weather over the country during month of February.

The resultant sub-divisionwise spatial rainfall distribution and frequency of *heavy* and *very heavy* rainfall are given in Table 6.

3.2.2. *Monthly rainfall*

Sub-divisionwise percentage departure and principal amounts of rainfall for the month of February are given in Tables 1 and 8 respectively.

Systems in the westerly flow gave rise to precipitation over northwest and northeastern parts of the country.

3.2.3. *Temperature*

February, being a transition period from winter to summer, the weather over most parts of the country is normally very comfortable. However, this year, the maximum temperatures attained during day time over many parts of the country were found to be exceptionally high, continuing the trend from the last week of January. The maximum temperatures over some regions like Orissa crossed even the 40° C mark during February 2009. A large number of stations reported maximum temperatures more than 5° C above the normal values.

The dates of occurrence of *cold waves* and dates on which the minimum temperature remained *appreciably tomarkedly above/below normal* as well as *above/below normal* are given in Table 7.

TABLE 8

Principal amounts of rainfall in cm over different stations for the months of January and February 2009

Date	January	February
(1)	(2)	(3)
1.	Nil	Passighat 3, Tezu 1
2.	Gangtok 1	Passighat & Dibrugarh 1 each
3.	Nancowry 3, Car Nicobar & Ziro 1 each	Sepla 1
4.	Dhundi 4, Solangnala 3, Kupwara 2, Nancowry, Amritsar, Pahalgam, Bhangmanali, Srinagar, Tehri, Bhuntar & Batote 1 each	Dhundi 1
5.	Bhangmanali & Dhundi 3 each, Solang Nala 1	Kupwara 1
6.	Nancowry & Mandla 1 each	Bhangmanali 9, Dhundi 7, Quazigund & Banihal 6 each, Srinagar, Pahalgam & Bhaderwah 5 each, Shahpurkandi & Batote 4 each, Madhopur, Solangnala, Avantipur, Pulwama, Udhampur & Bhasholi 3 each, R.S.Dam site, Pathankot, Manali, Patsio, Kheri, Kupwara, Kukernag, Dehragopipur& Nurpur 2 each, Ghamroor, Guler & Jammu 1 each
7.	Nancowry 7, Vedaranniyam 4, Quazigund & Mandla 3 each, Kukernag 2, Banihal, Nagapattinam, Gaya, Pendra & Ambikapur 1 each	Dhundi 7, Solangnala 3, Bharwain 2, Adampur, Pathankot, Bhangmanali, Patsio, Kheri, Hamirpur, Baijnath, Palampur, Keylong, Una, Bangana & Kupwara 1 each
8.	Rewa & Chennai 3 each, Hoshangabad, Puducherry & Karaikal 2 each, Quazigund, Kukernag, Jabalpur, Pendra, Cuddalore, Nagapattinam, Nancowry, Bankura, Krishnanagar, Hazaribagh, Rampurhat & Dhundi 1 each	Nil
9.	Jabalpur 3, Hazaribagh 2, Rajgarh, Damoh, Satna, Pendra, Ranchi & Shajapur 1 each	Car Nicobar 4, Nancowry 1
10.	Dhundhi, Nowgaon & Tikamagarh 3 each, Bhopal, Satna & Khajuraho 2 each, Solang Nala, Quazigund, Kukernag, Jhansi, Shajapur, Raisen, Jalgaon, Guna, Khandwa, Shajapur & Raisen 1 each	Solangnala 4, Dhundi, Kupwara, Pahalgam & Patsio 1 each
11.	Dhundi & Damoh 3 each, Bhopal, Raisen, Sagar & Solang Nala 1 each	Bhaderwah 5, Amritsar, Ludhiana, Shimla & Mukteswar 4 each, Sarsawa, Kalpa, Pahalgam, Jammu, Naraingarh, Quazigund & Banihal 3 each, Dehra Dun, Chandigarh, Bhawanikhera, Julana, Gohana, Sonupat, Jagadhari, Manali, Nahan, Una, Sunnibhajji, Kukernag, Batote, Katra & Patti 2 each, Pithoragarh, Nainital, Tehri, Hissar, Ambala, Sirsa, Dadri, Lohari, Tohana, Narwana, Kalka, Patiala, Mandi, Bhuntar, Sundernagar, Berthin, Kahu, Kasol, Nadaun, Sujanpurtira, Solangnala, Ghamroor, Guler, Avantipur, Srinagar, Udhampur, Nal & Satna 1 each
12.	Udaipur 1	Nainital 5, Shantiniketan, Tehri, Pithoragarh & Alapuzha 3 each, Dehra Dun, Pantnagar, Kohima, Malda, Krishnanagar & Phoolbagh 1 each
13.	Nil	Kupwara & Kanjirappally 1 each
14.	Nil	Batote & Banihal 4 each, Kukernag, Quazigund & Dharmasala 3 each, Kupwara, Bhaderwah, Dhundi & Bharwain 2 each, Bikaner, Sirsa, Guler, Patsio, Amritsar & Shahpurkandi 1 each
15.	Karaikal, Nagapattinam & Tondi 1 each	Pahalgam 1
16.	Banihal 3, Quazigund 2, Srinagar, Batote, Avantipur, Amritsar, Tiruchirapalli & Anantnag 1 each	Konni 2
17.	Dhundi 6, Pahalgam 5, Bhang Manali & Banihal 4 each, Kupwara, Quazigund, Kukernag & Batote 3 each, Keylong, Manali, Patsio, Khairi, Srinagar & Katra 2 each, Dharamashala, Ghamroor, Solang Nala, Avantipur, Udhampur, Bhaderwah, Patiala, Faridkot, Fazilka, Madhopur, Shahpurkandi, R.S. Dam site & Suratgarh 1 each	Nil

TABLE 8 (*Contd*.)

(1)	(2)	(3)
18.	Bhaderwah & Faridkot 2 each, Safidon, Julana, Srinagar, Quazigund, Pahalgam, Kupwara, Kukernag, Banihal, Batote, Katra, Amritsar, Fazilkara, Bhatinda, Churu, Uchana, Ghamroor, Solang Nala, Moga & Ganganagar 1 each	Nil
19.	Dhundi 7, Quazigund 5, Banihal 4, Manali, Khairi, Batote, Bhaderwah, Kukernag, Pahalgam, Katra, Avantipur, Udhampur, Bhasholi, Shahpurkandi, Pathankot & Anantnag 3 each, Solang Nala, Srinagar, Jammu, Kupwara, Hoshiarpur, Madhopur & R.S.Dam site 2 each, Kalpa, Sunnibhajji, Kahu, Sujanpurtira, Guler, Ghamroor, Bhuntar, Patsio, Dharamshala, Mukerian & Samrala 1 each	Gulmarg 1
20.	Nil	Dhundi 2, Banihal, Batote, Kupwara & Udaipur 1 each
21.	Nil	Kukernag 2, Kupwara 1
22.	Nil	Passighat 1
23.	Kalpa & Keylong 1 each	Kupwara, Gulmarg & Dhundi 2 each, Pahalgam, Banihal & Patsio 1 each
24.	Nil	Kukernag, Banihal & Bhangmanali 3 each, Pahalgam, Quazigund & Gulmarg 2 each, Patsio 1
25.	Pahalgam, Gulmarg, Banihal & Kupwara 1 each	Cherrapunji 10, Passighat 2, Ziro, Daporijo, Dibrugarh, Majbat, Pahalgam, Bhuntar & Dhundi 1 each
26.	Dibrugarh 4, Kukernag 3, Srinagar, Banihal, Quazigund, Batote, Avantipur, Bhaderwah & Kupwara 2 each, Pahalgam, Katra, Passighat & Lakhimpur 1 each	Passighat 3, Dibrugarh, Tezu & Daporijo 2 each, North Lakhimpur & Silchar 1 each
27.	Vedarnniyam 7, Jammu 5, Kupwara, Bhaderwah, Batote, Avantipur, Quazigund, Banihal, Kukernag, Adirampattinam & Kochi 2 each, Passighat, Pahalgam, Srinagar, Pamban & Nagapattinam 1 each	Passighat 3
28.	Passighat & Lakhimpur 2 each, Kodaikanal, Nagapattinam & Minicoy 1 each	Imphal 2, Passighat, Silchar, Kohima & Kailashahar 1 each
29.	Passighat 1	-
30.	Nil	-
31.	Nil	-

During the month, the lowest minimum temperature of 4° C was recorded at Amritsar on 1 & 7 February 2009.

3.2.4. *Disastrous weather events and damage*

No disastrous weather event was reported during the month.

Appendix

Definitions of the terms given in '*Italics*'

Rainfall

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

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

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

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

Heavy rain - rainfall amount from 6.5 cm to 12.4 cm.

Very heavy rainfall - rainfall amount 12.5 cm to 24.4 cm.

At most places - 76 % or more stations of a meteorological sub-division reporting at least 2.5 mm rainfall.

At many places - 51 % to 75 % stations of a meteorological sub-division reporting at least 2.5 mm rainfall.

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

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

Temperatures

As per the revised criteria for declaring cold wave, the actual minimum temperature of a station is reduced to 'Wind Chill Effective minimum temperature' (WCTn) based on the wind chill factor using the table given in WMO No. 331/ Technical Note No. 123. For declaring cold wave etc. WCTn only is used and when it is $\leq$ 10° C only, cold wave is considered (this criteria does not hold for coastal stations).

Severe cold wave conditions - departure of WCT_n from normal minimum temperature is −7° C or less for the regions where normal minimum temperature is $\geq$ 10° C and −6° C or less elsewhere.

Cold wave conditions - departure of WCTn from normal minimum temperature is from –5° C to –6° C where normal minimum temperature > 10° C and from –4° C to –5° C elsewhere.

Also cold wave is declared when WCTn is < 0° C irrespective of the normal minimum temperature for those stations.

Cold day conditions maximum day temperature is less than 16° C over the plains.

Markedly below normal - departure of minimum temperature from normal is from –5° C to –6° C for the region where the normal minimum temperature is 10° C or more and from –3° C to –4° C elsewhere.

Appreciably below normal - departure of minimum temperature from normal is from –3° C to –4° C for the region where the normal minimum temperature is 10° C or more.

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

Appreciably above normal - departure of minimum temperature from normal is from + 3° C to + 4° C.

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