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Weather in India

WINTER SEASON (January-February 2014)†

1. Introduction

The New Year day witnessed *heavy to very heavy snowfall* over the western Himalayan region, caused by an active Western Disturbance (WD). *Severe cold wave* / *cold wave* conditions prevailed over north and central parts of India all through the season. WDs remained active during the season, which resulted in heavy snow /rains and foggy conditions in hilly regions and northern plains.

Analogous to winter of previous year, the core of Sub-Tropical Westerly Jet (STWJ) was seen between Lat. 20° N & Lat. 30° N all through the season, allowing the systems in westerlies to traverse along more southern latitudes, at times even upto 12° N (during second half of January & last week of February). Occasionally their confluence with the systems in easterlies gave rise to precipitation over major parts of the country except for Northeastern parts of India which received *deficient* rainfall during the season. The resultant hailstorms occurred over parts of south peninsula, central and northern plains during the later part of February caused major damage to agriculture.

Apart from the above mentioned severe weather events, the season also witnessed the formation of a Depression over southwest Bay of Bengal, during the first week of January, which is a rare event. As per the available records since 1891, there had been only 7 intense low pressure systems, *viz*., one Severe Cyclonic Storm (7^{th} – 10^{th} January, 1939), two Cyclonic Storms (3^{rd} – 7^{th} January, 1929 & 2^{nd} – 7^{th} January, 1967) and 4 depressions (6^{th} – 12^{th} January, 1923, 3^{rd} – 5^{th} January 1963, 7^{th} – 10^{th} January, 1975 and 8^{th} January, 1986) formed over southern parts of Bay of Bengal during the first half of January.

With the further equator-ward shift of the Inter Tropical Convergence Zone, the northeast monsoon rains ceased over Tamil Nadu, Kerala and adjoining parts of Andhra Pradesh and Karnataka on 18^{th} January, 2014.

2. Seasonal Rainfall (January-February)

The monthly and seasonal sub-divisionwise rainfall (actual, normal & percentage departure) are given in Table 1. Also representative amounts of rainfall on a day-to-day basis are given in Table 4. Out of the 36 met-sub-divisions of India, the seasonal rainfall was *excess* in 16, *normal* in 6, *deficient* in 9 and *scanty* in 5 sub-divisions. The percentage departures falling under various categories, *viz*., *excess, normal, deficient* and *scanty* are shown in Fig. 1.

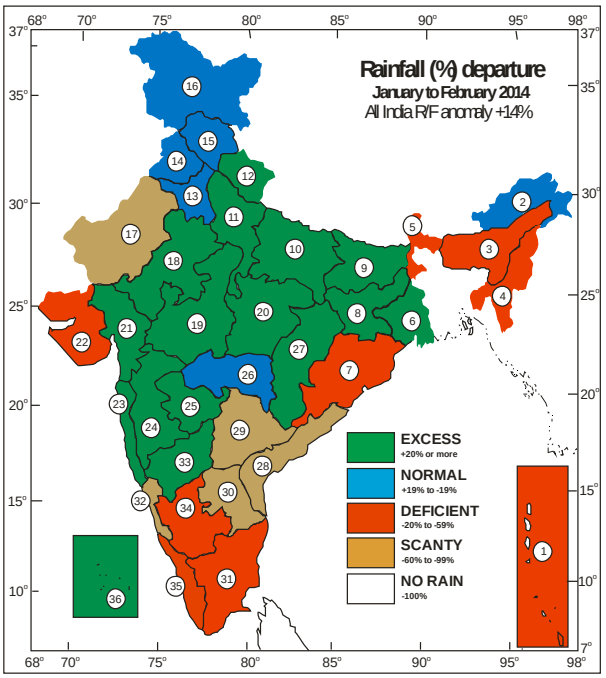

Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for winter season (January to February 2013). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	-39	**7**	-45	**13**	-8	**19**	341	**25**	118	**31**	-56
2	-18	**8**	72	**14**	-15	**20**	129	**26**	13	**32**	-86
3	-36	**9**	120	**15**	-5	**21**	601	**27**	41	**33**	57
4	-50	**10**	154	**16**	-8	**22**	-48	**28**	-90	**34**	-37
5	-55	**11**	134	**17**	-60	**23**	268	**29**	-82	**35**	-39
6	24	**12**	37	**18**	265	**24**	391	**30**	-91	**36**	95

Climatologically, the WDs 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

* *Definition of terms in 'italics' other than subtitles are given in Appendix.*

†*Compiled by* : Medha Khole, Sunitha Devi S. and A. P. Kundale, Meteorological Office, Pune – 411 005, India

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (January-February, 2014)

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	41.9	53.7	-22	8.6	29.2	-71	50.5	82.9	-39
2.	Arunachal Pradesh	19.0	50.1	-62	101.9	98.0	4	120.9	148.1	-18
3.	Assam & Meghalaya	2.0	16.4	-88	28.1	30.5	-8	30.1	46.9	-36
4.	Naga., Mani., Mizo. and Tri.	1.2	13.7	-91	21.0	30.3	-31	22.2	44.0	-50
5.	Sub-Himalayan West Bengal & Sikkim	0.2	26.6	-99	26.6	33.7	-21	26.8	60.3	-55
6.	Gangetic West Bengal	0.7	13.5	-95	41.9	20.9	100	42.6	34.4	24
7.	Orissa	0.0	10.8	-99	17.6	21.0	-16	17.6	31.8	-45
8.	Jharkhand	9.9	16.1	-38	47.5	17.3	174	57.4	33.4	72
9.	Bihar	17.0	13.3	28	33.5	9.7	245	50.5	23.0	120
10.	East Uttar Pradesh	47.5	16.8	183	25.8	12.1	113	73.3	28.9	154
11.	West Uttar Pradesh	48.4	18.2	166	29.5	15.1	95	77.9	33.3	134
12.	Uttaranchal	45.9	52.1	-12	99.9	54.1	85	145.8	106.2	37
13.	Haryana, Chandigarh & Delhi	13.0	17.8	-27	17.3	15.1	15	30.3	32.9	-8
14.	Punjab	21.8	25.2	-14	20.1	24.3	-17	41.9	49.5	-15
15.	Himachal Pradesh	66.3	97.5	-32	118.6	98.0	21	184.9	195.5	-5
16.	Jammu & Kashmir	105.4	95.7	10	89.6	117.2	-24	195.0	212.9	-8
17.	West Rajasthan	0.8	2.9	-73	2.2	4.5	-52	3.0	7.4	-60
18.	East Rajasthan	28.3	5.6	406	10.0	4.9	104	38.3	10.5	265
19.	West Madhya Pradesh	25.6	8.5	201	34.4	5.1	575	60.0	13.6	341
20.	East Madhya Pradesh	32.1	20.0	60	49.7	15.3	225	81.0	35.3	129
21.	Gujarat region	7.5	0.8	832	0.2	0.3	-29	7.7	1.1	601
22.	Saurashtra & Kutch	0.3	0.4	-18	0.0	0.2	-95	0.3	0.6	-48
23.	Konkan & Goa	0.1	0.1	-14	1.0	0.2	402	1.1	0.3	268
24.	Madhya Maharashtra	3.1	1.1	182	6.2	0.8	678	9.3	1.9	391
25.	Marathawada	1.4	3.8	-63	13.4	3.0	348	14.8	6.8	118
26.	Vidarbha	1.2	10.2	-89	18.3	7.0	161	19.5	17.2	13
27.	Chattisgarh	2.1	10.7	-80	27.8	10.6	163	30.0	21.3	41
28.	Coastal Andhra Pradesh	0.7	8.3	-92	1.2	10.4	-88	1.9	18.7	-90
29.	Telangana	0.1	5.8	-98	1.9	5.5	-65	2.0	11.3	-82
30.	Rayalaseema	0.1	3.0	-96	0.5	3.6	-86	0.6	6.6	-91
31.	Tamil Nadu	7.4	17.5	-58	6.1	13.4	-55	13.7	30.9	-56
32.	Coastal Karnataka	0.0	0.7	-100	0.1	0.2	-35	0.1	0.9	-86
33.	North interior Karnataka	0.0	2.2	-100	6.1	1.7	261	6.1	3.9	57
34.	South interior Karnataka	0.4	1.4	-71	2.4	3.0	-21	2.8	4.4	-37
35.	Kerala	4.6	8.7	-47	10.3	15.6	-34	14.9	24.3	-39
36.	Lakshadweep	53.2	20.8	156	16.1	14.7	10	69.3	35.5	95

Note : Amounts less than 0.1 mm are rounded off to zero.

TABLE 2

Details of the weather systems during January 2014

S. No.	System	Duration	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**) *Deep depressions/depression*						
1.	Depression	4 - 7	Southwest Bay of Bengal and neighbourhood near Lat. 8.5° N /Long. 83.5° E (470 kms southeast of Nagapattinam)	West & southwest	Sri Lanka, near Lat. 8.0° N / Long. 80.0° E	Details would be published in the article, Cyclones & depressions over the north Indian ocean during 2014 in the July, 2015 issue of Mausam
(**B**) *Western disturbances/eastward moving systems*						
(*i*) *Upper air cyclonic circulations*						
1.	Up mid tropospheric levels	7 - 11	Northeast Afghanistan and neighbourhood	Northeast	Eastern parts of Jammu & Kashmir	Moved away on 12
2.	Do	12 - 14	North Pakistan and neighbourhood	Do	Jammu & Kashmir and neighbourhood	Moved away on 15. It was first seen as a trough in mid & upper tropospheric levels on 11
3.	Do	30 - 31	Northeast Afghanistan and adjoining north Pakistan	Do	Eastern parts of Jammu & Kashmir	Moved away on 1 February
(*ii*) *Induced cyclonic circulation*						
1.	Upto mid tropospheric levels	18 - 19	Haryana and neighbourhood	Northeast	East Uttar Pradesh and neighbourhood	Moved away northeastwards on 19 evening
2.	Do	21 - 22	Rajasthan and neighbourhood	Stationary	*In situ*	less marked on 23
(*iii*) *Trough in westerlies*						
1.	Mid & Upper tropospheric levels	2 - 6	Long. 56° E, to the north of Lat. 25° N at 5.8 kms a.s.l.	Northeast	Long. 72° E, to the north of Lat. 25° N	Moved away on 7 evening
2.	Upper tropospheric level	7 - 10	Do	Do	Long. 72° E, to the north of Lat. 30° N	Moved away on 11
3.	Mid & upper tropospheric levels	14 - 18	Long. 55° E, to the north of Lat. 30° N at 5.8 kms a.s.l.	Do	Long. 70° E, to the north of Lat. 30° N	Moved away on 19. It lay as a cyclonic circulation extending upto mid tropospheric levels over central Pakistan and neighbourhood with a trough aloft on 17
4.	Between 1.5 kms & 3.1 kms a.s.l.	11 - 12	East Uttar Pradesh to west Madhya Pradesh	East	Eastern parts of Bihar to north Odisha	Less marked on 13
5.	Upto Mid & Upper tropospheric level	19 - 23	Long. 52° E, to the north of Lat. 20° N at 5.8 kms a.s.l.	Northeast	Jammu & Kashmir & neighbourhood	Moved away on 24. It lay as a cyclonic circulation extended upto 4.5 kms a.s.l. Jammu & Kashmir & neighbourhood on 23
6.	Do	24 - 26	Long. 68° E, to the north of Lat. 25° N at 5.8 kms a.s.l.	East	Long. 78° E, to the north of Lat. 30° N	Moved away east northeastwards on 27
7.	Do	31 Jan - 2 Feb	Long. 62° E, to the north of Lat. 25° N at 5.8 kms a.s.l.	Northeast	Long. 62° E, to the north of Lat. 25° N	Moved away northeastwards on 3 February
(**C**) *Other cyclonic circulations*						
1.	Between 1.5 kms & 3.1 kms a.s.l.	3	Gujarat and adjoining south Rajasthan	Stationary	*In situ*	Less marked on 4

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	Upto 3.1 kms a.s.l.	8	Southeast Pakistan and adjoining areas of Kutch and southwest Rajasthan	Stationary	*In situ*	Less marked on 9
3.	Up to 1.5 kms a.s.l.	10 - 11	Haryana and adjoining northeast Rajasthan	Southeast	East Madhya Pradesh and neighbourhood	Less marked on 12. Initially it extended as a trough in lower levels over west Uttar Pradesh to southeast Rajasthan on 9
4.	Upto lower tropospheric levels	13 - 18	South Rajasthan and neighbourhood	East	East Rajasthan and adjoining west Madhya Pradesh	Less marked on 19
5.	Between 1.5 kms & 3.1 kms a.s.l.	15 - 16	Haryana and neighbourhood	Stationary	*In situ*	Less marked on 17
6.	Upto 0.9 km a.s.l.	14 - 15	Comorin area and neighbourhood	West	Lakshadweep area and neighbourhood	It lay as a trough in lower level easterlies over southeast Arabian Sea and adjoining Lakshadweep area on 16 & 17 and moved away westwards on 18
7.	Upto 2.1 kms a.s.l.	20	South Rajasthan and adjoining Gujarat region	Stationary	*In situ*	Less marked on 21
8.	Between 1.5 kms & 3.1 kms a.s.l.	25	Haryana and neighbourhood	Do	Do	Less marked on 26
9.	Between 3.1 kms & 4.5 kms a.s.l.	29 - 31	Haryana and adjoining north Rajasthan & Punjab	East	West Uttar Pradesh and adjoining Haryana between lower-mid tropospheric levels	Became unimportant on 1 February
(**D**)	*Trough in easterlies*					
1	Trough of low (mean sea level)	10 - 13	South Andaman Sea and adjoining equatorial Indian Ocean	West	Southwest Bay of Bengal off Sri Lanka coast	It became less marked on 14
2.	Do	19 - 22	Southeast Bay of Bengal and neighbourhood	Do	Southwest Bay of Bengal and neighbourhood	Less marked on 23
3.	Do	27 - 31	Southwest Bay of Bengal off Sri Lanka coast	Do	Southwest Bay of Bengal and adjoining Sri Lanka	Less marked on 1 February
(**E**)	*North-south trough/wind discontinuity*					
1.	Lower levels	17	Southeast Rajasthan to Lakshadweep area across Gujarat Region and interior Maharashtra	Oscillatory	-	Less marked on 18
2.	Do	19 - 26	Lakshadweep area to southeast Rajasthan across east central Arabian Sea and Gujarat Region	Do	Lakshadweep to Konkan & Goa across east central Arabian Sea	Became unimportant on 27

interacting with the regional synoptic situations and topography of the region, give rise to precipitation over northwest and northeastern parts of the country during winter season. Unlike the year 2012, the impact of western disturbances did not remain confined to the extreme northern parts of India this year. Favourable interaction with the systems in easterlies, these systems gave rise to precipitation over major parts of the country resulting in *excess* rainfall situation over the many parts of the country. The Easterly-Westerly interaction throughout the

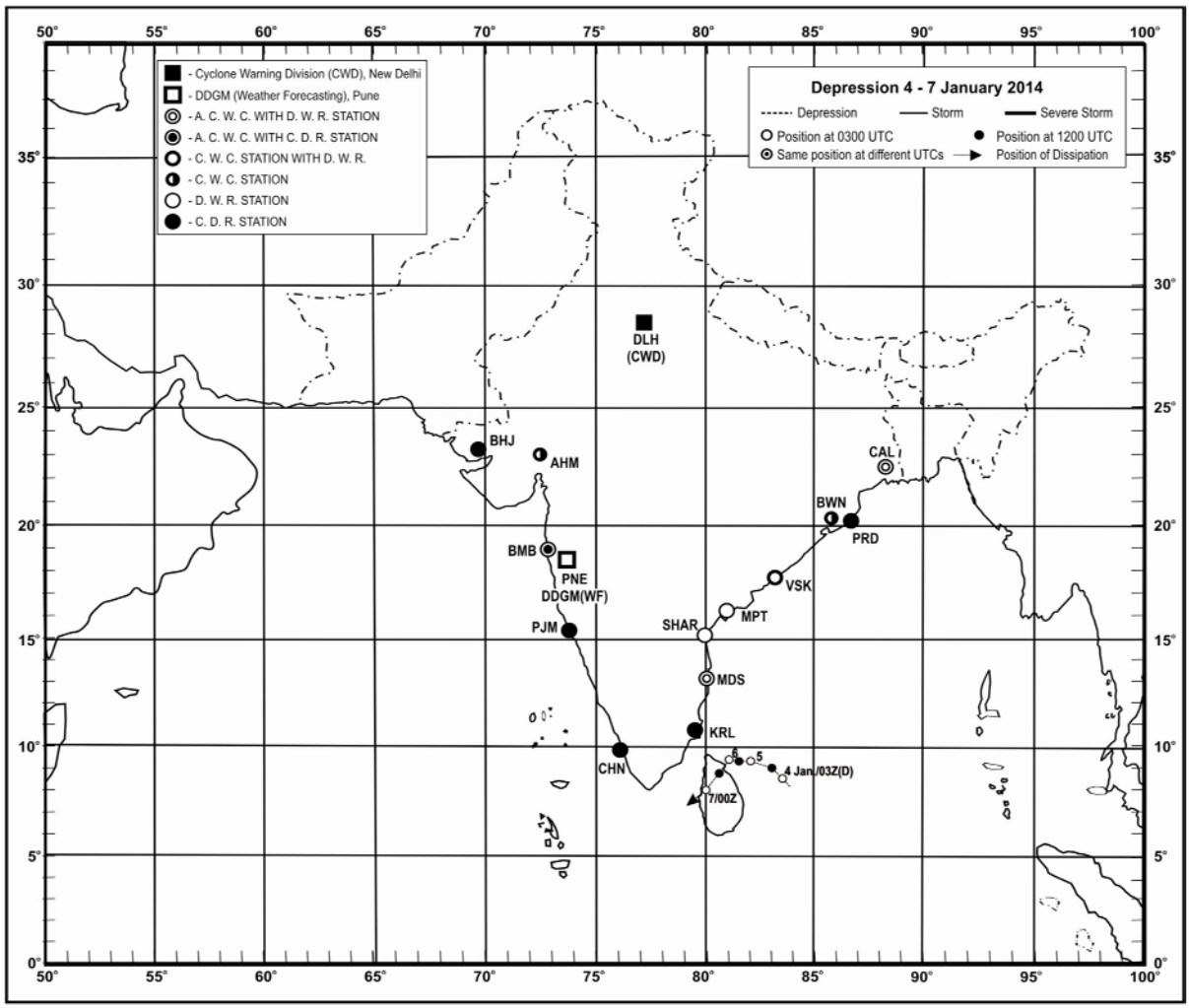

Fig. 2. Storms and Depressions (Provisional track) during the winter season 2014

season from the second week of January led to the above *normal* rainfall activity over many parts of the country except over northeast India and south and eastern parts of peninsular India which received *deficient/scanty* rainfall.

3. Monthly features

3.1. *January*

3.1.1. *Weather and associated synoptic features*

As given in Table 2, 12 WDs (including 2 induced low pressure area, 3 upper air cyclonic circulations and 7 troughs in westerlies), 1 Depression, 9 other cyclonic circulations, 3 troughs in easterlies and 2 north-south trough as wind discontinuity formed which affected the weather over the country during the month of January.

3.1.2. *Monthly rainfall*

Out of the 36 met-subdivisions of India, the month's rainfall was *excess* in 9, *normal* in 5, *deficient* in 6 and *scanty* in 14 sub-divisions. There was no rain in 2 sub-divisions.

A Depression formed over southwest Bay of Bengal in the easterly wave trough during 4^{th} – 7^{th} January, details of which are given in the article on Cyclonic Storms & Depressions over the north Indian Ocean, to be published in the July 2015 issue of Mausam. Track followed by the system is given in Fig. 2. Similar to the intense low pressure systems formed during December 2013, this Depression also weakened *in-situ* due to dry air intrusion at middle levels. This also exhibited a southwestward movement and caused rainfall only over the extreme

TABLE 3

Details of the weather systems during February 2014

S. No.	System	Duration	Place of first location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**) *Western disturbances / eastward moving systems*						
(*i*) *Upper air cyclonic circulations*						
1.	Up to mid tropospheric levels	1 - 4	Western parts of Afghanistan and neighbourhood	Northeast	Northern parts of Jammu & Kashmir and neighbourhood	Moved away eastnortheastwards on 5
2.	Up to 4.5 kms a.s.l.	5 - 6 M	North Pakistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	It initially lay as a trough in mid-upper tropospheric levels (axis at 5.8 kms a.s.l.) extended along Long. 66° E, to the north of Lat. 32° N on 4. A trough was also seen aloft along Long. 70° E, to the north of Lat. 30° N. The WD moved away northeastwards on 6 evening
3.	Do	7	Do	Do	Jammu & Kashmir and adjoining north Pakistan	It initially lay as a trough in mid-upper tropospheric levels (axis at 5.8 kms a.s.l.) extended along Long. 58° E, to the north at 27° N on 6. A trough was also seen aloft along Long. 70° E, to the north of Lat. 30° N. The WD moved away northeastwards on 8
4.	Up to mid tropospheric levels	17 - 20	North Afghanistan and neighbourhood	Do	Northern parts of Jammu & Kashmir	Moved away on 21
5.	Up to 3.1 kms a.s.l.	19 - 23	Western parts of Afghanistan and neighbourhood	Do	Eastern parts of Jammu & Kashmir and neighbourhood	It initially lay as a trough in mid-upper tropospheric levels (axis at 5.8 kms a.s.l.) extended along Long. 45° E, to the north of Lat. 20 °N on 17 and along Long. 52 °E, to the north of Lat. 25 °N on 18. A trough was also seen aloft (axis at 5.8 kms a.s.l.) during 19-23. The WD and the trough aloft moved away northeastwards on 24
6.	Up to 4.5 kms a.s.l	26 Feb - 2 Mar	Northeast Afghanistan and adjoining Pakistan	Do	Jammu & Kashmir and neighbourhood	It initially lay as a trough (axis at 5.8 kms a.s.l.) on 24 & 25. A trough aloft was also seen during 26 February - 2 March. It moved away on 3 March
(*ii*) *Troughs in westerlies*						
1.	Upto Mid & upper tropospheric level	8 - 11	Long. 68° E, to the north of Lat. 30° N	Northeast	Long. 73° E, to the north of Lat. 32° N	Moved away on 12
2.	Do	11 - 16	Long. 50° E, to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	Do	Long. 78° E, to the north of Lat. 30° N	Moved away on 17
3.	Do	26 - 27	Long. 62° E, to the north of Lat. 25° N at 5.8 kms a.s.l.	East-northeast	Long. 66° E, to the north of Lat. 25 ° N at 5.8 kms a.s.l.	Moved away on 28
(**B**) *Induced systems*						
(*i*) *As low pressure area*						
1.	Low pressure area	14 - 15	West Rajasthan and neighbourhood	East	North Rajasthan and neighbourhood	First seen as an induced cyclonic circulation extending between 1.5 & 3.1 kms a.s.l. over west Rajasthan and

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
						adjoining central Pakistan on 13. It became less marked on 17. Associated cyclonic circulation extended upto 3.1 kms a.s.l.
(*ii*)	*As cyclonic circulations*					
1.	Upto lower tropospheric levels	3 - 4	Central Pakistan and adjoining west Rajasthan	East	Central Pakistan and adjoining areas of west Rajasthan and Punjab	Less marked on 5
2.	Between 1.5 & 3.1 kms a.s.l.	26 Feb - 2 Mar	Haryana and adjoining Punjab	Do	Haryana and neighbourhood	Became less marked on 2 March evening.
3.	Do	6 - 8	Central Pakistan and adjoining areas of west Rajasthan and Punjab	Do	Haryana and adjoining Punjab	Less marked on 9
4.	Do	10 - 11	Punjab and adjoining Haryana	Do	Haryana and neighbourhood	Less marked on 12
5.	Up to 1.5 kms a.s.l.	19 - 22	Central Pakistan and neighbourhood	Do	Punjab and adjoining Haryana	Less marked on 23
(**C**)	*Other cyclonic circulations*					
1.	Upto 1.5 kms a.s.l.	1	Lakshadweep area & neighbourhood	Stationary	*In situ*	Less marked on 2
2.	Do	4 - 5	Do	West	Lakshadweep-Maldives area	Less marked on 6
3.	Do	8 - 11	Assam & Meghalaya and neighbourhood	Stationary	*In situ*	It lay as a trough between 1.5 & 3.1 kms a.s.l. from western parts of Assam to north Bay of Bengal across Bangla Desh on 12. It became less marked on 13
4.	Do	12	South Chhattisgarh and neighbourhood	Do	Do	Less marked on 13
5.	Do	12 - 16	South Gujarat and adjoining areas of north Konkan & northeast Arabian Sea	North	East Rajasthan and neighbourhood	Less marked on 17
6.	Up to lower tropospheric levels	13 - 15	Nagaland-Manipur-Mizoram-Tripura and neighbourhood	Northeast	Assam & Meghalaya and neighbourhood	Less marked on 16
7.	Do	15 - 16	Chhattisgarh and neighbourhood	East	Chhattisgarh and adjoining areas of Odisha	Less marked on 17
8.	Do	19 - 23	Lakshadweep area and neighbourhood	Oscillatory	Lakshadweep-Maldives areas	It was seen as a trough/wind discontinuity at lower levels extended from Lakshadweep area to north Tamil Nadu coast across Kerala on 17 and from Comorin area to north interior Karnataka on 21.The cyclonic circulation became less marked on 24
9.	Do	22 - 23	West Madhya Pradesh and adjoining southeast	East	East Madhya Pradesh and adjoining Chhattisgarh	Became less marked on 24
10.	Upto 0.9 km a.s.l.	22	Southern parts of Bihar and adjoining Jharkhand	Stationary	*In situ*	Became less marked on 23
11.	Up to lower tropospheric levels	23 - 25	North Madhya Maharashtra and adjoining Gujarat Region	Do	Gujarat Region and neighbourhood	Became unimportant on 26
12.	Upto 3.1 kms a.s.l.	26 Feb - 1 Mar	East Rajasthan and adjoining west Madhya Pradesh	Oscillatory	Northwest Madhya Pradesh and adjoining southwest Uttar Pradesh	Became less marked on 2 March

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	Upto 0.9 km a.s.l	26	Chhattisgarh and neighbourhood	Stationary	*In situ*	Became less marked on 27
(**D**)	*Troughs in easterlies*					
1.	At lower levels	19	Comorin and neighbourhood to east central Arabian Sea off Karnataka coast	Stationary	*In situ*	Became unimportant on 20
2.	At mean sea level	20 - 24	South Andaman Sea and neighbourhood	West	Southwest Bay of Bengal off Tamil Nadu coast	Became less marked on 25
3.	At lower levels	24 - 26	Lakshadweep area to south Gujarat coast	Do	Lakshadweep - Maldives area to north interior Karnataka	Became less marked on 27
4.	Do	28 Feb - 5 Mar	Comorin area to interior part of Tamil Nadu	Oscillatory	Lakshadweep area to south Gujarat coast	It lay as a trough of low at mean sea level on 4 & 5.Less marked on 6 March
(**E**)	*North-south trough/wind discontinuity*					
1.	Upto lower levels	9 - 10	Arunachal Pradesh to northwest of Bay of Bengal across Assam & Meghalaya	Oscillatory	Arunachal Pradesh to northwest of Bay of Bengal off west Bengal coast	Less marked on 11
2.	Do	17 - 18 M	Assam & Meghalaya to northwest Bay of Bengal	Do	*In situ*	Moved away on18 evening
3.	At 0.9 km a.s.l.	27 - 28	East Rajasthan to south interior Karnataka across west Madhya Pradesh, interior Maharashtra and north interior Karnataka	Do	-	Less marked on 1 March

southern parts of Tamil Nadu. Some *isolated very heavy rainfall* also occurred on 8th January, over south Tamil Nadu, after the weakening of the system.

The perturbations in the westerlies were stronger and occupied a wider latitudinal belt and their interaction with easterlies, gave precipitation over parts of north, central and northeast India, during the remaining part of the month.

3.1.3. *Temperature*

Severe cold wave/cold wave prevailed over north & northwestern parts during the initial half and over eastern and central parts in the latter half of January (a few days over parts of Odisha, Uttar Pradesh, Haryana, Jammu & Kashmir, west Rajasthan, east Madhya Pradesh, Saurashtra & Kutch and Vidarbha,) where as *cold day conditions* prevailed over northern plains almost throughout January.

Minimum temperatures were *appreciably / markedly below normal* over major parts of north India and some parts of interior and western parts of peninsular India; *markedly*/*appreciably above normal* over some parts of central India and *normal* over northeast and peninsular India during the first week and initial few days of second week. During the later part of second and third week, increasing trend was seen over major parts of the country outside peninsular India exhibiting *appreciably to markedly above normal* temperatures. Thereafter the temperatures dipped and were *appreciably / markedly below normal* over parts of east, northeast, central and adjoining northern parts of peninsular India during the last week of January.

During the initial half of January the strong westerlies and its wide latitudinal spread caused the cold air advection which also resulted in persistent fog across north India. Hence during this period, the maximum temperatures were also *markedly* to *appreciably below*

TABLE 4

Date	Some representative amounts of rainfall in cm for January and February 2014 (7 cm and above)
1 Jan	Srinagar IAF 14, Batote 9, Harran AWS and Pahalgam 7 each
2 Jan	Nancowry 9
3 Jan	Car Nicobar IAF 8
4 Jan	Nil
5 Jan	Nil
6 Jan	Nil
7 Jan	Nil
8 Jan	Nil
9 Jan	Papanasam 18, Manimutharu 12, Mylaudy 8
10 Jan	Siswan 8
11 Jan	Nil
12 Jan	Nancowry 12
13 Jan	Nil
14 Jan	Nil
15 Jan	Thiruvananthapuram AP 7
16 Jan	Nil
17 Jan	Nil
18 Jan	Soraon 15, Mawana and Sidhauli 10 each, Kalpi Tehsil 9, Mau Tehsil, Kanpur Teh and Safipur 8 each, Anupshahr, Kanpur AP, Kanpur city and Bara 7 each
19 Jan	Phoolbagh 8
20 Jan	Nil
21 Jan	Nil
22 Jan	Banihal, Sapotra and Sikrai 7 each
23 Jan	Srinagar IAF 16, Nangal and Una 9 each, Chabra, Chipabarod and Una Rampur AWS 8 each, R L Bbmb, BanganaR, BanganaF, Dhundi, Dharamasala, Mehre (Barsar), Balachaur and Amb 7 each
24 Jan	Nil
25 Jan	Nil
26 Jan	Nil
27 Jan	Nil
28 Jan	Nil
29 Jan	Nil
30 Jan	Nil
31 Jan	Nil
1 Feb	Nil
2 Feb	Nil

TABLE 4 (*Contd.*)

Date	Some representative amounts of rainfall in cm for January and February 2014 (7cm and above)
3 Feb	Nil
4 Feb	Nil
5 Feb	Nil
6 Feb	Nil
7 Feb	Jogindarnagar 7
8 Feb	Nil
9 Feb	Nil
10 Feb	Nil
11 Feb	Nil
12 Feb	Nil
13 Feb	Nil
14 Feb	Nil
15 Feb	Jhajha 10, Phoolbagh, Banka and Baikunthpur 9 each, Keertinagar 8, Mukteswar and Hardwar 7 each
16 Feb	Udala 8, D.P.Ghat 7
17 Feb	Nilgiri, Jajpur and Tigiria ARG 8 each, Korei ARG, Cherrapunji, Rajghat, Athgarh, Khandapara and Pattamundai 7 each
18 Feb	Nil
19 Feb	Nil
20 Feb	Nil
21 Feb	Nil
22 Feb	Nil
23 Feb	Nil
24 Feb	Nil
25 Feb	Nil
26 Feb	Hosanagar and Ashta -Arg 7 each
27 Feb	Gwalior 7
28 Feb	Thakurdwara 7

normal over major parts of north, west, northwest, and adjoining central India. It was *normal/above normal* over Peninsular India This trend continued in the later half except over western Himalayan region and northeastern parts where it was *appreciably to markedly above normal* and interior peninsular region where it was *below normal.*

The maximum temperatures were about 3-6 °C below normal over parts of northern plains and adjoining central and peninsular India during first three weeks of January 2014. As compared to last year, where 7 stations in plains reported sub-zero temperatures during January, only one station reported sub-zero temperature this year.

Analogous to December' 2013, Kashmir valley continued to reel under extreme cold. Many places, *viz*.; Kargil AF (minus 21.6 °C on 30th), Leh (minus 18.9 °C, on 12th), Pahalgam (minus 14.7 °C on 7th) and Gulmarg (minus 12.0 °C, on 30th) reported sub-zero temperatures.

The month's and the season's lowest minimum temperature over the plains of the country was minus 2.7 °C recorded at Churu (west Rajasthan) on 3rd January, 2014.

3.1.4. *Disastrous weather events and damage*

According to press and media reports, heavy snowfall and avalanche in Jammu & Kashmir claimed 3 lives. Due to heavy rain & snow, the Jammu-Srinagar National Highway was closed for a few days. *Cold wave/severe cold wave* claimed 29 lives in Uttar Pradesh and 4 in Rajasthan. Dense fog related incidents claimed 14 lives in Uttar Pradesh and 6 in Haryana. Poor visibility and thick fog affected normal life, air and surface transport services in north India.

3.2. *February*

3.2.1. *Storms and depressions*

No intense low pressure system formed over the Indian seas during the month.

3.2.2. *Other synoptic features and associated weather*

As given in Table 3, 17 WDs (including 1 induced low pressure area, 6 upper air cyclonic circulations, 5 induced cyclonic circulations and 5 troughs in westerlies), 13 upper air cyclonic circulations, 4 troughs in the easterlies and 1 north-south trough as wind discontinuity formed which affected the weather over the country during the month of February.

3.2.3. *Monthly rainfall*

Out of the 36 met-subdivisions, the month's rainfall was *excess* in 16, normal in 6, *deficient* in 9 and *scanty* in 5 sub-divisions.

Perturbations in the westerlies and the induced low pressure area caused *scattered to fairly widespread* precipitation over parts of western Himalayan regions, east, northeast, central and adjoining peninsular India during the month.

Wind confluence and moisture influx from north Indian Sea caused *scattered to widespread* rainfall and isolated thunderstorms/hailstorms over northern plains, east, central and adjoining northern parts of peninsular India.

3.2.4. *Temperature*

February, being a transition period from winter to summer, the weather over most parts of the country during the month is normally very comfortable. This year, widespread thunderstorm/hailstorm activity occurred over northern plains, northeast, central and adjoining peninsular India in the second half of February.

Severe cold wave conditions prevailed on 5 days over some parts of Odisha and on 1 to 2 days over east Uttar Pradesh, Haryana, east Madhya Pradesh, Vidarbha and Chhattisgarh. *Cold wave conditions* prevailed on 4 to 7 days over some parts of Gangetic West Bengal, Odisha and east Madhya Pradesh and on 1 to 3 days over some parts of Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, west Rajasthan, west Madhya Pradesh, Gujarat State, Madhya Maharashtra, Vidarbha and Chhattisgarh. *Cold Day conditions* prevailed on 5 days over west Uttar Pradesh and on 1 to 3 days over east Uttar Pradesh, Haryana and Punjab.

Minimum temperatures were *markedly above /above normal* over east, central and adjoining peninsular India during the first and last week and *markedly below/below normal* during the mid- February over many parts of the country.

Maximum temperatures were *appreciably below/markedly below normal* during the mid-February over many parts of the country and on a few days over some parts during the first and the last week of the month. They were generally *appreciably above/above normal* over the remaining days of the month.

The sub-divisions like Jammu & Kashmir and Himachal Pradesh in the western Himalayan region recorded *appreciably/markedly above normal* temperatures on a few days during the month.

During the month, the lowest minimum temperature over the plains of the country was 1.0 °C recorded at Amritsar (Punjab) on 18th February.

3.2.5. *Disastrous weather events and damage*

According to press and media reports, Avalanche/landslide claimed 3 lives in Jammu & Kashmir. Lightning claimed 1 life in Jammu & Kashmir. Hailstorm claimed 5 lives in Madhya Pradesh and 4 in Maharashtra.

Rain and hailstorm damaged standing crops in Haryana, Punjab, Madhya Pradesh, Maharashtra and

Andhra Pradesh. Moderate to heavy snowfall in the higher reaches of Himachal Pradesh stalled vehicular traffic over the Hindustan-Tibet Road.

Appendix

Definitions of the terms given in '*Italics*'

Snowfall

Heavy - 35.6 cm to 64.4cm

Very heavy - 64.5 to 124.4cm

Rainfall

Heavy - 64.5 to 124.4cm

Very heavy - ≥124.5 to 244.4mm

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 %.

No rain (NR) - –100%.

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 $\geq$ 10° C and from –4 °C to –5 °C elsewhere.

Also cold wave is declared when WCTn is $\leq$ 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.

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

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

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.