MAUSAM, **67**, 1 (January 2016), 311-322

Weather in India

WINTER SEASON (January-February 2015)†

1. Introduction

The season witnessed several active Western Disturbances (WDs) precipitating across the western Himalayan region, interaction of troughs in the tropical easterlies and mid-latitude westerlies causing fairly widespread rainfall over central and adjoining peninsular India and northern plains of India, apart from dense fog and cold wave conditions over the northern plains.

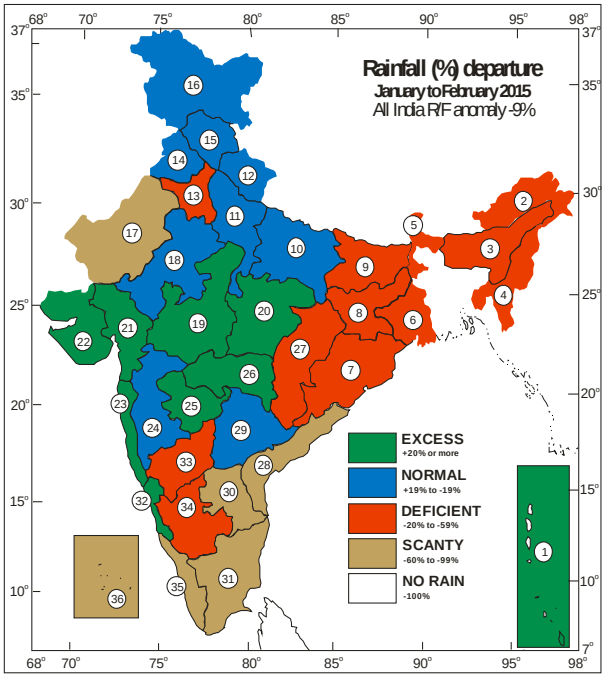
This winter, the core of Sub-Tropical Westerly Jet (STWJ) was seen between Lat. 22 °N & Lat. 30 °N all through the season, allowing the systems in westerlies to traverse along more southern latitudes. Occasionally, their confluence with the systems in easterlies gave rise to precipitation over major parts of the country outside northeast and south peninsular India which received *deficient/scanty** rainfall during the season.

This season, no low pressure area over the Indian Seas intensified into Depression or Cyclonic Storm. However, a well marked low pressure area formed during previous season persisted as a low pressure area over westcentral Bay of Bengal for the first two days of the season and a WD as a Western Depression formed over central Pakistan and adjoining Punjab and north Rajasthan during last week of the season.

With the further shift of the Inter Tropical Convergence Zone towards the equator, resulting in a consistent reduction in rainfall, the northeast monsoon rains ceased over Tamil Nadu, Kerala and adjoining parts of Andhra Pradesh and Karnataka on 4th January 2015.

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 9, *normal* in 9, *deficient* in 12 and *scanty* in 6 sub-divisions. The percentage departures falling under various categories *viz*., *excess*, *normal*, *deficient* and *scanty* are shown in Fig. 1.



EXCESS -09 NORMAL -09 DEFICIENT - 12 SCANTY -06 NO RAIN -00

Fig. 1. Sub-divisionwise rainfall percentage departures for the season Jan-Feb 2015. 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	62	**7**	-42	**13**	-42	**19**	238	**25**	72	**31**	-66
2	-50	**8**	-58	**14**	-1	**20**	37	**26**	80	**32**	120
3	-40	**9**	-35	**15**	9	**21**	77	**27**	-48	**33**	-39
4	-37	**10**	18	**16**	1	**22**	94	**28**	-88	**34**	-56
5	-51	**11**	16	**17**	-70	**23**	517	**29**	8	**35**	-67
6	-49	**12**	10	**18**	14	**24**	14	**30**	-79	**36**	-93

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. On interacting with the regional synoptic situations and topography of the region, these systems give rise to precipitation over northwest and northeastern parts of the country during winter season. The rainfall during the season was near normal.

* *Definitions of terms in italics other5 than sub-titles are given in Appendix*

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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	126.8	53.7	136	7.6	29.2	-74	134.4	82.9	62
2.	Arunachal Pradesh	30.8	50.1	-39	47.6	98.0	-51	74.2	148.1	-50
3.	Assam & Meghalaya	13.5	16.4	-18	15.3	30.5	-50	27.9	46.9	-40
4.	Naga., Mani., Mizo. and Tri.	16.7	13.7	22	12.3	30.3	-59	27.6	44.0	-37
5.	Sub-Himalayan West Bengal & Sikkim	15.7	26.6	-41	14.2	33.7	-58	29.4	60.3	-51
6.	Gangetic West Bengal	13.3	13.5	-1	4.4	20.9	-79	17.7	34.4	-49
7.	Orissa	15.0	10.8	39	3.3	21.0	-84	18.4	31.8	-42
8.	Jharkhand	12.2	16.1	-24	2.6	17.3	-85	14.0	33.4	-58
9.	Bihar	12.7	13.3	-4	1.8	9.7	-82	15.0	23.0	-35
10.	East Uttar Pradesh	30.1	16.8	79	3.5	12.1	-71	34.2	28.9	18
11.	West Uttar Pradesh	31.9	18.2	75	6.2	15.1	-59	38.8	33.3	16
12.	Uttaranchal	54.5	52.1	5	62.6	54.1	16	116.9	106.2	10
13.	Haryana, Chandigarh & Delhi	12.4	17.8	-31	6.5	15.1	-57	18.9	32.9	-42
14.	Punjab	17.7	25.2	-30	31.3	24.3	29	49.0	49.5	-1
15.	Himachal Pradesh	67.5	97.5	-31	145.1	98.0	48	212.6	195.5	9
16.	Jammu & Kashmir	26.9	95.7	-72	187.2	117.2	60	215.1	212.9	1
17.	West Rajasthan	1.3	2.9	-55	0.8	4.5	-82	2.2	7.4	-70
18.	East Rajasthan	9.7	5.6	72	0.1	4.9	-98	11.9	10.5	14
19.	West Madhya Pradesh	39.2	8.5	361	6.2	5.1	22	46.0	13.6	238.0
20.	East Madhya Pradesh	37.2	20.0	86	11.0	15.3	-28	48.3	35.3	37
21.	Gujarat region	1.9	0.8	142	0.0	0.3	-100	1.9	1.1	77
22.	Saurashtra & Kutch	1.2	0.4	191	0.0	0.2	-100	1.2	0.6	94
23.	Konkan & Goa	1.6	0.1	1511	0.0	0.2	-100	1.9	0.3	517
24.	Madhya Maharashtra	1.4	1.1	25	0.8	0.8	-5	2.2	1.9	14
25.	Marathawada	9.5	3.8	150	1.6	3.0	-48	11.7	6.8	72
26.	Vidarbha	26.3	10.2	158	4.7	7.0	-33	31.0	17.2	80
27.	Chattisgarh	16.4	10.7	53	0.8	10.6	-93	11.0	21.3	-48
28.	Coastal Andhra Pradesh	1.7	8.3	-79	0.5	10.4	-95	2.2	18.7	-88
29.	Telangana	12.2	5.8	110	0.0	3.6	-100	12.2	11.3	8
30.	Rayalaseema	1.4	3.0	-54	0.0	5.5	-100	1.4	6.6	-79
31.	Tamil Nadu	8.3	17.5	-53	2.3	13.4	-83	10.6	30.9	-66
32.	Coastal Karnataka	1.5	0.7	109	0.5	0.2	133	2.0	0.9	120
33.	North interior Karnataka	2.4	2.2	8	0.0	1.7	-100	2.4	3.9	-39
34.	South interior Karnataka	2.2	1.4	55	0.2	3.0	-92	2.0	4.4	-56
35.	Kerala	3.1	8.7	-65	5.8	15.6	-63	8.1	24.3	-67
36.	Lakshadweep	2.2	20.8	-89	0.5	14.7	-97	2.6	35.5	-93

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

TABLE 2

Details of the weather systems during January 2015

S. No.	System	Duration	Place of first location	Direction of movement	Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Low pressure area*					
1.	Induced Low pressure area	20	Southeast Pakistan and adjoining areas of Kutch	Stationary	*In situ*	It became less marked on 21. However, associated cyclonic circulation persisted over Saurashtra & Kutch
(**B**)	*Western disturbances/eastward moving systems*					
(*i*)	*Upper air cyclonic circulations*					
1.	Upto mid tropospheric levels	11-15	Northeast Afghanistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away on 16. It was seen as a trough in mid & upper tropospheric levels with its axis at 5.8 kms a.s.l. extended along Long. 67° E, to the north of Lat. 30° N on 13
2.	Do	19-23	Eastern parts of Iran and adjoining Afghanistan	Do	Long.72° E, to the north of Lat 25° N at 5.8 kms a.s.l.	The trough moved away on 24. A trough aloft with its axis at 5.8 kms. a.s.l. was seen during 19-23.
3.	Do	31 Jan - 3 Feb	Western parts of Afghanistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	It moved away northeastwards on 4. A trough aloft extended upto 7.6 kms a.s.l. during 2 & 3 February
(*ii*)	*Induced cyclonic circulation*					
1.	Upto mid tropospheric levels	13-15	Punjab and neighbourhood	Northeast	West Uttar Pradesh and neighbourhood	Moved away on 16
2.	upto lower tropospheric levels	21-22	Saurashtra & Kutch and neighbourhood	Do	Southeast Rajasthan and neighbourhood	Less marked on 23. It was associated with the induced low pressure area
3.	Do	21-23	North Rajasthan and adjoini Punjab and neighbourhood		West Uttar Pradesh and neighbourhood	Became less marked on 24
4.	Do	29	Central Pakistan and adjoini Punjab and west Rajasthan	Stationary	*In situ*	Became less marked on 30
(*iii*)	*Trough in westerlies*					
1.	Upto Mid & Upper tropospheric level	3-4	Long. 68° E, to the north of Lat. 30° N (axis at 5.8 kms a.s.l)	East-Northeast	Long. 77° E, to the north of Lat. 35° N	Moved away on 5. Initially it lay as a cyclonic circulation extending upto 3.1 kms a.s.l. over north Pakistan and neighbourhood on 2
2.	Do	5-6	Long. 58° E, to the north of Lat. 35° N (axis at 5.8 kms a.s.l)	Do	Long. 72° E, to the north of Lat. 35° N	Moved away on 7. It was a feeble W.D.
3.	Do	25-28	Long. 65° E, to the north of Lat. 25° N (axis at 5.8 kms a.s.l)	Northeast	Long. 73° E, to the north of Lat. 30° N	Moved away on 29
4.	Do	29	Long. 72° E, to the north of Lat. 30° N (axis at 5.8 kms a.s.l)	Stationary	*In situ*	Moved away northeastward on 30
5.	Do	30	Long. 85° E, to the north of Lat. 28° N	Do	Do	Moved away eastward on 31
(**B**)	*Other cyclonic circulations*					
1.	At lower levels	1	South Tamil Nadu and neighbourhood	Stationary	*In situ*	Less marked on 2
2.	Upto mid tropospheric levels	3-4	Comorin area and adjoining south Tamil Nadu.	West	Lakshadweep area and neighbourhood	Less marked on 5

TABLE 2 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Upto lower tropospheric levels	5-9	Equatorial Indian Ocean and adjoining southwest Bay of Bengal off Sri Lanka coast	Northwest	Sri Lanka and neighbourhood	Became unimportant on 10
4.	Upto mid tropospheric levels	7-10	Bangla Desh and neighbourhood	East	Nagaland-Manipur-Mizoram-Tripura and neighbourhood	Became unimportant on 11. A trough aloft present on 8 & 9
5.	At lower levels	7	Lakshadweep area and neighbourhood	Stationary	*In situ*	Less marked on 8
6.	Upto lower tropospheric levels	9-10	Do	Do	Do	Less marked on 11
7.	Upto mid tropospheric levels	13-15	Southwest Bay of Bengal off Sri Lanka coast	West	Sri Lanka and adjoining southwest Bay of Bengal	Became unimportant on 16
8.	Upto lower tropospheric levels	19	Gujarat and neighbourhood	Stationary	*In situ*	Merged with the induced low pressure area over southeast Pakistan and adjoining areas of Kutch on 20
9.	Do	15-19	Bangla Desh and neighbourhood	East	Tripura and neighbourhood	Became less marked on 20
10.	Upto lower levels	17	Maldives-Comorin areas	Stationary	*In situ*	Became less marked on 18
11.	Between lower & mid tropospheric levels	22	Comorin and neighbourhood	Do	Do	Moving westwards it became un important on 23
12.	Upto lower tropospheric levels	23	Madhya Maharashtra and neighbourhood	Do	*In situ*	Became less marked on 24
13.	Do	24-26	Kutch and adjoining southwest Rajasthan	Northeast	East Rajasthan and neighbourhood	It lay as a trough extending upto 1.5 kms a.s.l. from southwest Uttar Pradesh to southeast Rajasthan on 27; east Uttar Pradesh to southwest Madhya Pradesh on 28 and from north Bihar to northeast Madhya Pradesh on 29. It became less marked on 30
14.	Upto mid tropospheric levels	25-29	Tripura and neighbourhood	Quasi Stationary	Bangla Desh and neighbourhood	Became less marked on 30. It was seen as a trough in the lower tropospheric levels from Assam to Bangla Desh on 28
15.	Upto lower levels	26	Lakshadweep area and neighbourhood	Stationary	*In situ*	Became less marked on 27
16.	Upto lower tropospheric levels	28	Comorin area and neighbourhood	Do	Do	Moved westward and became unimportant on 29
(**C**)	*Trough in easterlies*					
1.	At lower levels	2	From cyclonic circulation over northeast Arabian Sea and adjoining areas of Gujarat to northeast Rajasthan	Stationary	*In situ*	Less marked on 3
2.	Trough of low (mean sea level)	11-18	South Andaman Sea and neighbourhood	West	East central Bay of Bengal to northeast Bay of Bengal	Less marked on 19. Initially it lay as a cyclonic circulation extending upto 1.5 kms. a.s.l. over Malay peninsula and neighbourhood during 8 – 10. A cyclonic circulation aloft extending upto 1.5 kms. a.s.l. during 11-13
3.	Do	20-30	Malay Peninsula and neighbourhood	Do	Maldives and adjoining Lakshadweep area	It lay as an upper air cyclonic circulation extending upto 3.1 kms a.s.l. over Lakshadweep area and neighbourhood on 31 and became less marked on 1 February

TABLE 3

Details of the weather systems during February 2015

S. No.	System	Duration	Place of first location	Direction of movement	Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Western disturbances/eastward moving systems*					
(*i*)	*Western depression*					
1.	Western Depression	25-27	Central Pakistan and adjoining Punjab and north Rajasthan	North northeast	Jammu & Kashmir and adjoining north Pakistan	Moved away northeastwards on 28.It lay as an induced low pressure area over south Afghanistan and neighbourhood on 23 & 24 with associated cyclonic circulation extending upto lower tropospheric levels
(*ii*)	*Upper air cyclonic circulations*					
1.	Up to mid tropospheric levels	6-9	Afghanistan and neighbourhood	Northeast	Eastern parts of Jammu & Kashmir	Moved away northeastwards on 10
2.	Do	19	Jammu & Kashmir and neighbourhood	Do	Do	Move away northeastwards on 20. Initially it lay as a trough in mid tropospheric westerlies extended along Long. 71° E, to the north of Lat 30° N (axis at 5.8 kms a.s.l.) on 18
3.	Do	13	North Pakistan and neighbourhood	Do	Do	Moved away northeastwards on 14. It was a feeble W.D.
4.	Do	20-21	Afghanistan and adjoining north Pakistan	Do	Do	Initially it lay as a trough in mid tropospheric westerlies extended along Long. 66° E, to the north of Lat 30° N (axis at 5.8 kms a.s.l.) on 19. A trough aloft persisted over the same region. It moved away northeastwards on 22 evening
5.	Do	20-21	Iran and neighbourhood	East	Afghanistan and adjoining north Pakistan	Merged with the cyclonic circulation associated with western Depression on 25. A trough aloft with its axis at 5.8 kms a.s.l. during 22 to 24
6.	Do	27 Feb - 3 Mar	Iran and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	Moved away northeastwards on 4 Feb. A trough aloft with its axis at 5.8 kms a.s.l. persisted during 27 February - 3 March
(*iii*)	*Troughs in westerlies*					
1.	Upto mid tropospheric levels	6-9	Long. 62° E, to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	Northeast	Long. 74° E, to the north of Lat. 20° N	Moved away northeastward on 10. It was seen aloft a cyclonic circulation over the region
2.	Do	10-11	Long. 65° E, to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	Do	Long. 72° E, to the north of Lat. 25° N	Moved away northeastward on 12
3.	Between lower & mid tropospheric levels	11-12	Saurashtra & Kutch to east central Arabian Sea	Oscillatory	Northwest Uttar Pradesh to northeast Arabian sea across east Rajasthan and Gujarat Region	Became less marked on 13
4.	Mid & Upper tropospheric levels	15-17	Long. 52° E, to the north of Lat. 20° N (axis at 5.8 kms a.s.l.)	East	Long. 70° E, to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	Moved away northeastwards on 18

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	Mid & Upper tropospheric levels	13	Long. 89° E, to the north of Lat. 20° N (axis at 5.8 kms a.s.l.)	Stationary	*In situ*	Moved away northeastwards on 14
(*iv*)	*Induced systems*					
(*a*)	*As low pressure area*					
1.	Low pressure area	16-17	Central Pakistan and neighbourhood	East	Northeast Rajasthan and neighbourhood	Initially it lay as an induced cyclonic circulation extending upto lower tropospheric levels over central Pakistan and neighbourhood on 15. It became less marked on 18. Associated cyclonic circulation extended upto lower tropospheric levels
(*b*)	*As cyclonic circulations*					
1.	Upto mid tropospheric levels	1-3	Central Pakistan and adjoining west Rajasthan	East	North Rajasthan and neighbourhood	Less marked on 4
2.	Do	6-8	Central Pakistan and neighbourhood	Do	South Rajasthan and neighbourhood	Became less marked on 9
3.	Upto lower tropospheric levels	11	Northwest Rajasthan and neighbourhood	Stationary	*In situ*	Less marked on 12
4.	Do	19-21	South Pakistan and adjoining west Rajasthan	Northeast	Haryana and adjoining west Uttar Pradesh and northeast Rajasthan	Became less marked on 22
5.	Upto mid tropospheric levels	28 Feb - 2 Mar	South Pakistan and adjoining Kutch	East	South Rajasthan and adjoining Gujarat	Became less marked on 3 March
(**B**)	*Other cyclonic circulations*					
1.	Upto Lower tropospheric levels	2	Punjab and adjoining Haryana, Chandigarh & Delhi	Stationary	*In situ*	Merged with the induced cyclonic circulation on 3
2.	Do	2-7	Western parts of Assam & Meghalaya and adjoining Bangla Desh	West	Bangla Desh and neighbourhood	Less marked on 8
3.	Upto lower levels	8-9	East Madhya Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 10
4.	Upto mid tropospheric levels	11-19	Eastern parts of Bangla Desh and neighbourhood	East	Bangla Desh and adjoining Assam & Meghalaya	Became un-important on 20
5.	Upto lower levels	12	Southeast Madhya Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 13
6.	Do	14	Gangetic West Bengal and neighbourhood	Southwest	Southwest Bay of Bengal and adjoining northwest Bay of Bengal and north Odisha	Became less marked on 15
7.	Upto Lower tropospheric levels	15-18	Bihar and adjoining Jharkhand	East	South Gangetic West Bengal and adjoining Bangla Desh	Became less marked on 19
8.	Upto lower levels	16	Interior Tamil Nadu and adjoining Kerala	Stationary	*In situ*	Became less marked on 17
9.	Do	18	Lakshadweep area and neighbourhood	Do	Do	Became less marked on 19
10.	Upto Lower tropospheric levels	18	East Uttar Pradesh and adjoining east Madhya Pradesh	Do	Do	Became less marked on 19

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
11.	Upto lower levels	18	Southeast Rajasthan and west Madhya Pradesh	Stationary	*In situ*	Became less marked on 19
12.	Do	20	Lakshadweep area and neighbourhood	Do	Do	Became less marked on 21
13.	Do	21-23	Comorin area and neighbourhood	Do	Do	Became less marked on 24
14.	Upto Lower tropospheric levels	22-24	South Andaman Sea and neighbourhood	West	Southwest Bay of Bengal and adjoining Sri Lanka coast	Became less marked on 25
15.	Do	25-26	Comorin area and neighbourhood	Do	Lakshadweep area and neighbourhood	Moved away westwards on 27
16.	Do	27-28	Comorin area and adjoining Sri Lanka	Stationary	*In situ*	Became less marked on 1 March
17.	Do	26-27	North Madhya Pradesh	-	Chhattisgarh and adjoining Odisha	It lay embedded in the trough V(2). Became less marked on 28
(**D**)	*Troughs in easterlies*					
1.	At mean sea level	1-12	South Andaman Sea and adjoining southeast Bay of Bengal	West	Lakshadweep area to north Konkan	Became unimportant on 13. Associated cyclonic circulation extended upto mid tropospheric levels on 8 & 9
2.	Do	9-14	Southeast Bay of Bengal and neighbourhood	Do	Comorin area and neighbourhood	Became un-important on 15. Initially it lay as a cyclonic circulation extending upto mid tropospheric levels over Gulf of Siam and neighbourhood on 7 & 8
3.	Do	18-19	South Andaman Sea and adjoining southeast Bay of Bengal	Do	Southeast Bay of Bengal and neighbourhood	Became less marked on 20
(**E**)	*Wind discontinuity/North - South trough*					
1.	Upto Lower tropospheric levels	20-25	Assam & Meghalaya to south Odisha across Bangla Desh and Gangetic West Bengal	Oscillatory	Assam to Odisha across Bangla Desh	Became less marked on 26. Initially it lay as an upper air cyclonic circulation at lower levels over Chhattisgarh and Odisha on 18 and as a trough extending from Bihar to south Chhattisgarh with embedded cyclonic circulation over the same region on 19
2.	Upto mid tropospheric levels	27-28	Central Uttar Pradesh to north interior Karnataka	Do	Bihar to Vidarbha	Became less marked on 1 March

3. *Monthly features*

3.1. *January*

3.1.1. *Storms and depressions*

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

3.1.2. *Weather and associated synoptic features*

As given in Table 2, 13 WDs (including 1 induced low pressure area, 3 upper air cyclonic circulations, 4 induced cyclonic circulations, and 5 troughs in westerlies), 16 upper air cyclonic circulations and 3 troughs in easterlies formed which affected the weather over the country during the month of January.

3.1.3. *Monthly rainfall*

Out of the 36 met-subdivisions of India, the month's rainfall was *excess* in 18, *normal* in 5, *deficient* in 9 and *scanty* in 4 sub-divisions.

The first week of the month witnessed a favourable interaction of two circulation regimes which caused fairly

TABLE 4

Date	Some representative amounts of rainfall in cm for January and February 2015 (3 cm and above)
1 Jan	Bhainsdehi 14, Marandahalli 9, Sarangpur and Chikhalda 8 each, Begumganj 7, Attur and Natham 6 each, Atner, Patur, Agar, Burhanpur, Mehkar, Pennagaram, Khategaon, Kamatchipuram, Dewas - AWS, Kannod - Arg, Anjangaon, Sangrampur, Sonkatch and Paratwada 5 each, Barshitakli, Sailana, Betul, Betul - AWS, Ashta-Arg, Mettupatti, Akola, Khandwa, Khandwa - AWS, Tozhudur, Dindigul, Tarana, Tirumangalam, Shajapur, Biaora, Lateri, Tonkhurd, Shajapur - AWS, Palani and Badnagar 4 each, Chatrapatti (Odanchatra), Depalpur, Mhow, Narsingarh, Shujalpur, Hoskote, Akot, Telhara, Bagli, Chicholi, Narsingpur, atta, Neyyattinkara, Sagar, Sagar - AWS, Berhampur, Gautampura, Isagarh, Khachrod, Harsud - Arg, Nusrulgunj - Arg, Vedasandur, Digapahandi ARG, Khaknar, Palacode, Chandur Bazar, Raisen, Raisen - AWS, Bengaluru AP, Bengaluru Hal AP, Ashoknagar - AWS, Mohana, Khargaon, Guna, Guna - AWS, Devakottai, Indore, Indore - AWS, Chachoda, Sironj, Perambalur, Khirkiya - Arg, Pandhana, Chikhli, Hingoli - Hyd, Belaguntha ARG, Suvasara, Hogenekal, Ichhawar, Nepanagar, Susner, Sehore - AWS and Periyakulam 3 each
2 Jan	Kakatpur 17, Astaranga ARG 15, Maihar 11, Bhainsdehi 9, Atner and Paradip 8 each, Sonkatch, K. Paramathy and Paramathivelur 7 each, Korpana, Chikhalda and Multai 6 each, Saoli, Betul, Betul - AWS, Dehgam ARG, Anjangaon, Chandbali, Paratwada, Gudh, Kollimalai ARG, Mirzapur Tehsil, Puri, Tigiria ARG, Rewa, Rewa - AWS, Handia and Ballarpur 5 each, Nandipet, Chicholi, Rajkanika, Varanasi AP, Soraon, Sirkali, Gadarwara, Brahmagiri AWS, Marsaghai ARG, Gorakhpur, Robertsganj, Darwha, Nirmal, Mul, Balikuda ARG, Bansgaon, Satna, Satna - AWS, Chayal, Hindol, Kendrapara, Bara, Ralegaon, Nirmal (Arg) and Gop 4 each, Daryapur, Alipingal, Ghorawal, Pachmarhi, Deori, Tendukheda, Shegaon , Nimpara, Amraoti, Derabis ARG, Allahabad AP, Karchhana, Arvi, Gadchiroli, Udaipura, Sendamangalam, Allahabad Sadar, Utnur, Nayagarh, Kantapada ARG, Kannod - Arg, Kaneli, Chandur Bazar, Chandur Rlwy, Katni - AWS, Varanasi city, Sidhi, Amarwara, Sidhi - AWS, Bhadravati, Sindkhed Raja, Jagatsinghpur AWS, Angul, Warud, Kunda, Pratapgarh T, Rehli, Babulgaon, Umerkhed, Ranjal, Khandapara, Jabalpur, Pattamundai, Churk, Chindwara - AWS, Umaria, Umaria - AWS, Yeotmal, Bargaon, Gyanpur, Mayanur, Mau Tehsil, Thathiengrpet, Sundargarh, Binjharpur ARG, Ashta -Arg, Janakpur, Umari, Sultanpur and Sultanpur 3 each
3 Jan	Champawa and Asifabad 6 each, Joshimath, Bambasa, Katihar, Dhundi, Pithoragarh, Asifabad (Arg), Pargi, Deoprayag, Mukteswar, Manihari and Nainital 5 each, Munsyari, Balasore, Samakhunta AWS, Baripada, Lakhandur, Rajkanika and Chandrapur 4 each, Ranikhet (G), Sangareddy, Chandanpur, Jaleswar, Mehgawan, Bhadravati, Baltara, Banka, Suar, Kursela, Gondpipri, Sabour, Kalaikunda, Utarala, Kosgi, Nagina, Jakholi, Pawayan, Godda, Rudraprayag, Thakurdwara, Pakuria, Deori, Kodawanpur / C. Bii, Kanpur Teh, Nh5 Gobindpur, Nighasan, Bahraich, Arjuni Morgaon, Gurumitkal and Wani 3 each
4 Jan	Manthani 8, Belaguntha ARG and Luxettipet 7 each, Ramagundam, Julapalle, Sironcha, Sarangapur, Karimnagar and Madhabarida 6 each, Dharmapuri, Bihpur, Kolkata AP, Kumarsain, Joshimath and Sultanabad 5 each, Titlagarh, Gohar, Dhanora, Nuzvid, Bijapur, Nainital, Madanpur Rampur, Mancherial, Thimmapur, Dhundi and Gariabund 4 each, Bishrampur, Bhopalpatnam, Jagtial, Ahiri, Dhamtari, Chennur, Chamoli, Kosani (U Prob), Dhubri, Mallial, Turekela, Dhubri CWC, Sirpur T, Bagodar I, Kamareddy, Bejjanki, Sundernagar, Alipurduar CWC, Sirsilla, Bhavani P., Raikia ARG, Purulia, Munsyari, Narmetta, Daspalla, Maddur, Bijahi, Deoprayag and Bashirhat 3 each
5 Jan	Bokajan and Imphal 3 each
6 Jan	Nil
7 Jan	Nil
8 Jan	Nil
9 Jan	Nil
10 Jan	Hut Bay 5, Nancowry 4
11 Jan	Nancowry 6, Car Nicobar IAF 3
12 Jan	Nancowry 4
13 Jan	Nil
14 Jan	Dhundi 5, Tissa 4
15 Jan	Maya Bandar 6
16 Jan	Hut Bay 6, Long Islands 5, Maya Bandar 4, Car Nicobar 3
17 Jan	Port Blair 7, Maya Bandar 5, - Long Islands 4
18 Jan	Nil
19 Jan	Nil
20 Jan	Taliparamba 3
21 Jan	Nil
22 Jan	Dhundi 9, Patsio 4, Banihal, Manali, Bhang, Batote, Amritsar IAF, Keylong, Tatgarh, Chamba, Saloni, Rajouri, Rajgarh, Govindpura AWS, Jogindarnagar, Bari and Unjha 3 each
23 Jan	Nangal and Dhundi 6 each, Una, Una Rampur AWS, Palampur, Hamirpur, Bangana F and R L Bbmb 4 each, Dharampur, Kasauli, Bisalpur, Sujanpur Tira, Morni, Hamirpur AWS, Nadaun, BanganaR, Panchkula AWS, Kharar, Berthin AGRO, Baheri, Chandigarh Sase AWS, Baijnath, Mehre (Barsar), Gohar, Barwala, Ambala, Aurphambra Road ARG, Gohad, Dharmasala and Rajpura 3 each

TABLE 4 (*Contd*.)

Date	Some representative amounts of rainfall in cm for January and February 2015 (3 cm and above)
24 Jan	Nil
25 Jan	Indore, Indore - AWS and Mhow 3 each
26 Jan	Manjhanpur, Kurwai, Beberu, Kunda and Kasganj 3 each
27 Jan	Manjhanpur 4, Dhundi 3
28 Jan	Dhundi and Jogindarnagar 3 each
29 Jan	Daltonganj, Gudh, Dudhi and Maihar 3 each
30 Jan	Dhundi and Maheshpur 3 each
31 Jan	Anini AWS 4, Tuting 3
1 Feb	Nil
2 Feb	Gulmarg and Dhundi 3 each
3 Feb	Dhundi 12, Kalpa, Baderwah and Katra 5 each, Amritsar IAF, Batote, Banihal, Udaipur, Bhang, Jammu City, Saloni, Manali and Dharamasala 4 each, Chhatrari, Purola, Jammu IAF, Govindpura AWS, Barkot, Dharmshala AWS, Palampur, Kasauli, Rajpura, Sangraha, Karsog, Kheri, Dharampur, Baldwara, Moorang, Kukernag, Patiala Rev, Arki, Sunibhajji, Joshimath, Chamba AWS, Jogindarnagar, Patiala, Solan, Baijnath, Kandaghat, Kangra AP, Samba, Bijahi, Karnal, Chandigarh Sase AWS, Patiala AWS, Hamirpur AWS, Udhampur IAF and Mehre (Barsar) 3 each
4 Feb	Kheri 6, Chamba AWS 5, Dharmshala AWS, Chamoli, Saloni, Banihal, Katra and Batote 4 each, Jubbal, Govindpura AWS, Baderwah, Kangra AP, Udhampur IAF, Joshimath, Mukerian, Ranjit Sagar Dam Site, Pahalgam, Dharamasala, Patsio, Phangota and Shalimar AGRO 3 each
5 Feb	Nil
6 Feb	Nil
7 Feb	Cherthala 3
8 Feb	Lalitpur and Ashoknagar - AWS 3 each
9 Feb	Lakhnadon 5
10 Feb	Tiruchendur 3
11 Feb	Chicholi 4, Saoner 3
12 Feb	Ghatagaon 4, Anandpur 3
13 Feb	Seoni and Seoni - AWS 5 each, Passighat 4, Tadong, Kakatpur, Mangan and Binjharpur ARG 3 each
14 Feb	Neamatighat 3
15 Feb	Kollam Rly 3
16 Feb	Nil
17 Feb	Bhang, Dhundi, Bhuntar AP, Kapurtala, Bajaura AGRO, Seo Bagh, Sarahan and Manali 3 each
18 Feb	Nil
19 Feb	Batote 6, Udhampur IAF 5, Saloni 4, Khagadia, Dhundi, Bhoranj, Munsyari, Baramulla AWS, Govindpura AWS, Tissa and Agartala AP 3 each
20 Feb	Udhampur IAF 10, Dhundi 8, Gohar, Tissa, Bhuntar AP, Nagarkata and Saloni 7 each, Seo Bagh, Banihal and Bajura AWS 6 each, Govindpura AWS, Sarahan, Bajaura AGRO, Banjar, Baderwah, Mukerian, Jaleswar, Kapurtala and Tibri 5 each, Bhang, Bijahi, Kheri, Kawa AWS, Katra, Dalhousi Alha AWS, Rampur Bushar, Ghamroor, Jammu City, Patti, Jubbal, Keylong, ChathaAgro AWS, Karsog, Mehre (Barsar), Kalpa and Sundernagar 4 each, Gurudaspur, Kumarsain, Manali, Jhandutta, Pahalgam, R L Bbmb, Rajouri, Nakodar, Jammu IAF, Cooch Behar, Jogindarnagar, Gurdaspur AWS, Baijnath, Gulmarg, Srinagar IAF, Kukernag, Chhatrari, Bhoranj, Hamirpur, Awantipur IAF, Dehra Gopipur, Patsio, Mashobra AGRO, Kapurthala AWS, Bilaspur AWS, Palampur, Samba, Baldwara, Rajghat, Berthin AGRO, Rohru, Morni, Amb, BanganaF and Srinagar 3 each
21 Feb	Tinder and Gohar 5 each, Reckong Peo AWS, Rampur Bushar and Umrer 4 each, Seo Bagh, Kalpa, Sunibhajji, Kotkhai, Dharampur, Bhuntar AP, Sarahan, Kumarsain, Rohru, Barkot, Banjar, Cheslea School AWS, Bajaura AGRO, Shimla, Mashobra AGRO and Manali 3 each
22 Feb	Kamalpur, Passighat, Chhamonu, Kailashahar, Gharmura and Bhimnagar 3 each
23 Feb	Nil
24 Feb	Nil

TABLE 4 (*Contd*.)

Date	Some representative amounts of rainfall in cm for January and February 2015 (3 cm and above)
25 Feb	Banihal 8, Kupwara 7, Dalhousi Alha AWS and Govindpura AWS 6 each, Baramulla AWS, Pahalgam, Tissa, Baderwah, Kukernag, Shalimar AGRO, Batote, Anantnag, Srinagar IAF, Srinagar, Chamba, Chamba AWS and Dhundi 5 each, Saloni, Srinagar AGRO AWS, Malangpura AWS, Awantipur IAF, Patsio, Konibal, Quazigund, Udhampur IAF, Gulmarg, Keylong and Chhatrari 4 each, Kheri, Manali, Seo Bagh, Gund, Pahalgam AWS, Karsog and Sunibhajji 3 each
26 Feb	Dhundi and Patsio 6 each, Manali, Kheri and Meerut Teh 5 each, Baderwah, Saloni, Meerath, Kalpa, Pahalgam, Tissa, Pahalgam AWS and Palampur 4 each, Jogindarnagar, Bharmaur, Keylong, Barkot, Joshimath, Bhatwari, Chamba AWS, Amroha, Dasuya, Baramulla AWS, Rohru, Munsyari, Baijnath, Konibal, Srinagar AGRO AWS, Banihal, Uttar Kashi, Mukerian, Bhoranj, Shalimar AGRO, Jubbal, Govindpura AWS, Uttar Kashi CWC, Quazigund, Moradabad, Bhang and Mukteswar 3 each
27 Feb	Deoprayag 4, Tinsukia, Sevoke, Passighat, Tezu, Haflong, Anini AWS and Kalpa 3 each
28 Feb	Sankarankoil 11, Mylaudy 8, Aranmanaipudur 7, Tuting 6, Anini AWS and Kalugumalai 5 each, Radhapuram, Tirumayam and Vazhapadi 4 each, Aryankavu, Thiruchuzhi and Watrap each 3

widespread rainfall over central and adjoining peninsular India and northern plains of India. Thereafter the westerly circulation regime dominated the lower and upper tropospheric levels over the Indian sub-continent which led to widespread precipitation over the western Himalayan region and northwest India. In the second half, the passage of WDs and the systems induced by them caused isolated to widespread precipitation over western Himalayan region, northern plains, central India and parts of northeastern states.

3.1.4. *Temperature*

The perturbations in the westerly wind regimes and moisture incursion from the tropical Seas in the presence of easterlies confined the cold wave conditions to parts of central and eastern sub-divisions during the first week of January. Thereafter, the predominance of westerlies led to re-establishment of *severe cold wave/cold wave* conditions over the country.

Severe cold wave conditions prevailed on 1 to 3 days in some parts of Madhya Pradesh, Vidarbha and interior Karnataka. *Cold wave* conditions prevailed on 12 to 13 days in some parts of west Madhya Pradesh and Vidarbha, 4 to 7 days in some parts of Odisha, Madhya Maharashtra and Chhattisgarh and 1 to 3 days in some parts of Assam & Meghalaya, West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, Haryana, Chandigarh & Delhi, Himachal Pradesh, east Rajasthan, Saurashtra & Kutch, Marathwada, Telangana and interior Karnataka. *Cold day* conditions prevailed on 23 days in some parts of west Uttar Pradesh, 13 to 16 days in some parts of east Uttar Pradesh and Punjab, 5 to 6 days in some parts of Haryana, Chandigarh & Delhi and west Madhya Pradesh and 2 to 3 days in some parts of Bihar, Rajasthan, east Madhya Pradesh and Konkan & Goa.

Maximum temperatures were appreciably to markedly below normal for most of the days over sub-divisions in the north and central India outside Himachal Pradesh, Jammu & Kashmir and Rajasthan where temperatures were appreciably to markedly above normal and normal over Vidarbha and Chhattisgarh. Similarly subdivisions in the extreme east exhibited above normal to appreciably above normal temperatures except sub-divisions in the east *viz*., Sub-Himalayan West Bengal & Sikkim, Odisha, Bihar and Jharkhand where temperatures were normal/below normal for most of the days. Peninsular India exhibited normal temperatures for most of the days.

Analogous to December' 2014, Kashmir valley continued to reel under extreme cold. Many places *viz*.; Kargil AF (minus 17.2° C on 9th), Leh (minus 17.1° C, on 2nd), Pahalgam (minus 11.2° C on 30th) and Gulmarg (minus 10.6° C, on 28th) reported sub-zero temperatures.

The month's and the season's lowest minimum temperature over the plains of the country was minus 1.0° C recorded at Amritsar (Punjab) on 28th January 2015.

3.1.5. *Disastrous weather events and damage*

According to press and media reports, heavy snowfall and avalanche in Jammu & Kashmir claimed 1 life. Due to heavy rain & snow, the Jammu-Srinagar National Highway was closed for a few days. *Cold wave/severe cold wave* claimed 8 lives in Uttar Pradesh. Poor visibility and thick fog affected normal life and air/train 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. However, a Western Depression formed over central Pakistan and adjoining

Punjab and Rajasthan in the last week of the month and lasted for a couple of days. It gave above normal precipitation over the western Himalayan region.

3.2.2. *Other synoptic features and associated weather*

As given in Table 3, 18 WDs (including 1 western Depression,1 induced low pressure area, 6 upper air cyclonic circulations, 5 induced cyclonic circulations and 5 troughs in westerlies), 17 upper air cyclonic circulations, 3 troughs in the easterlies and 2 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 5, *normal* in 2, *deficient* in 9 and *scanty* in 14 sub-divisions. There was no rain in 6 sub-divisions.

The rainfall activity during the month was confined to northern, central and eastern/northeastern parts of the country. The passage of WDs caused *widespread* precipitation over western Himalayan region and rainfall at *isolated* places over the northern plains and central India during the first half of the month. It remained confined to northern most parts of India during the third week. *Isolated* to *scattered* thunderstorm/hailstorm activity was observed over northern parts of India during last two weeks of February.

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 comfortable. *Cold wave conditions* prevailed during the first week only and abated thereafter. Foggy conditions prevailed at isolated places over the northern parts of the country almost throughout the month.

Cold wave conditions prevailed on 1 to 2 days in some parts of Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Gangetic West Bengal, Odisha, east Uttar Pradesh, east Madhya Pradesh, Vidarbha and Chhattisgarh. *Cold day conditions* prevailed on 1 day in some parts of Coastal Andhra Pradesh.

Minimum temperatures were above normal over central and northern parts of country and below normal over most parts of peninsula.

Maximum temperatures were generally above normal throughout the country.

In this month, many stations *viz*., Kargil AF (minus 21.0° C on 6th), Leh (minus 14.1° C, on 5th), Pahalgam (minus 11.2° C on 5th) and Gulmarg (minus 10.0° C, on 5th) reported sub-zero temperatures.

During the month, the lowest minimum temperature recorded over the plains of the country was 3.0^0 C at Amritsar (Punjab) on 5th & 6th February.

3.2.5. *Disastrous weather events and damage*

According to press and media reports, Avalanche/landslide claimed 2 lives in Assam and 1 in Jammu & Kashmir. Lightning claimed 8 lives in Uttar Pradesh. Fog related incidents claimed 11 lives in Rajasthan.

Appendix

Definitions of the terms given in '*Italics*'

Snowfall

Heavy	- 35.6 cm to 64.4 cm.
Very heavy	- 64.5 to 124.4 cm.

Rainfall

Heavy	- 64.5 to 124.4 cm.
Very heavy	- ≥124.5 to 244.4 mm.
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 ≥ 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.

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.