

Weather in India

WINTER SEASON (January-February 2005)*

1. Introduction

The season was marked by intense cold in North India and a two day's spell of heavy snowfall, unprecedented of its kind in the recent past over Jammu & Kashmir. Snow and avalanches claimed the lives of more than 500 people in Jammu & Kashmir and disrupted road, rail transports, all means of communication and thus befitting the media caption – a 'Snow Tsunami'. These could be attributed to the active western disturbances which traversed across northwest India, almost in succession.

Another noticeable feature is the formation of a cyclonic storm during 13-17 January; which is rather unusual in this season. In the past history available on tropical cyclones (Storm Track Atlas, 1877 - 1990 and accounts on storms & depressions over the North Indian Ocean, published in MAUSAM till 2004), there were only 7 systems of tropical cyclone intensity occurred in January over the north Indian Oceans.

Regarding rainfall activity, unlike the previous winter, rainfall this year had been quite good, owing to both the westerly and easterly wave activities.

2. Seasonal rainfall (January-February)

The seasonal rainfall was *excess*[†] in 14 meteorological sub-divisions, viz., Arunachal Pradesh, Assam & Meghalaya, Gangetic West Bengal, Jharkhand, Haryana, Punjab, Jammu & Kashmir, west Rajasthan, Vidarbha, Chattisgarh, Telangana, Rayalaseema, north interior Karnataka and south interior Karnataka; *normal* in 9, viz., Sub-Himalayan West Bengal & Sikkim, Orissa, Bihar, east Uttar Pradesh, Uttaranchal, Himachal Pradesh, east Madhya Pradesh, Marathwada and Kerala; *deficient* in 7, viz., Nagaland-Manipur-Mizoram-Tripura, west Uttar Pradesh, west Madhya Pradesh, coastal Andhra Pradesh, Tamil Nadu, coastal Karnataka and Lakshadweep and *scanty* in 5, viz., Andaman & Nicobar Islands, east Rajasthan, Gujarat Region, Konkan & Goa and Madhya Maharashtra. Saurashtra & Kutch remained mainly dry during the season.

Seasonal sub-divisionwise percentage rainfall departures are given in Fig. 1 and also in Table 1.

[†] Definitions of the terms in *Italics other than subtitles* are given in Appendix.

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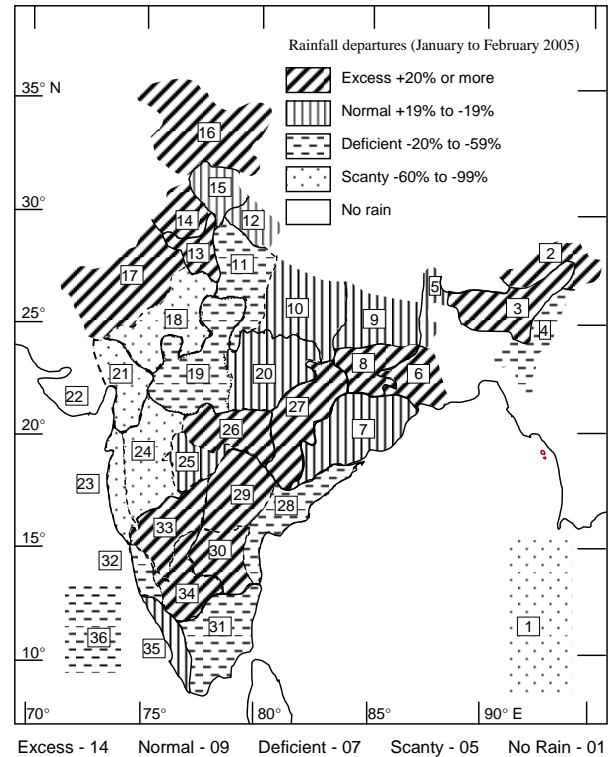


Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for winter season (January - February 2005). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1 -78	7 12	13 57	19 -52	25 13	31 -57
2 35	8 20	14 109	20 17	26 313	32 -47
3 33	9 5	15 2	21 -99	27 185	33 113
4 -32	10 -14	16 120	22 -100	28 -30	34 152
5 -3	11 -21	17 65	23 -87	29 328	35 -4
6 27	12 1	18 -63	24 -73	30 74	36 -22

3. Monthly features

3.1. January

3.1.1. Weather and associated synoptic features

3.1.1(a). Cyclonic Storm over southeast Bay and adjoining equatorial Indian Ocean during 13 to 17 January 2005

A trough in the easterlies at sea level over southeast and adjoining southwest Bay organised into a low

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (January-February 2005)

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	19	56	-66	0	29	-100	19	85	-78
2.	Arunachal Pradesh	53	49	8	133	89	50	186	138	35
3.	Assam & Meghalaya	25	18	39	34	27	29	59	45	33
4.	Naga., Mani., Mizo. and Tri.	4	14	-71	24	27	-11	28	41	-32
5.	S. H. W. B. & Sikkim	22	19	16	25	30	-16	47	49	-3
6.	Gangetic West Bengal	28	13	107	13	19	-29	41	32	27
7.	Orissa	31	12	156	5	20	-75	36	32	12
8.	Jharkhand	22	19	19	25	21	20	47	39	20
9.	Bihar	16	17	-6	14	12	21	30	28	5
10.	East Uttar Pradesh	14	19	-28	15	14	4	29	33	-14
11.	West Uttar Pradesh	12	20	-42	17	16	5	29	36	-21
12.	Uttaranchal	35	60	-42	82	56	48	117	116	1
13.	Haryana, Chandigarh & Delhi	17	20	-13	39	16	145	56	36	57
14.	Punjab	45	27	65	62	24	160	107	51	109
15.	Himachal Pradesh	67	100	-33	128	92	39	195	192	2
16.	Jammu & Kashmir	151	106	43	364	128	184	515	234	120
17.	West Rajasthan	1	4	-69	12	4	186	13	8	65
18.	East Rajasthan	1	6	-88	3	5	-32	4	11	-63
19.	West Madhya Pradesh	6	11	-44	2	6	-69	8	17	-52
20.	East Madhya Pradesh	41	26	61	11	19	-43	52	45	17
21.	Gujarat Region	0	1	-99	0	1	-100	0	2	-99
22.	Saurashtra & Kutch	0	1	-100	0	1	-100	0	2	-100
23.	Konkan & Goa	**	1	-93	**	**	-62	**	1	-87
24.	Madhya Maharashtra	1	2	-62	**	1	-94	1	4	-73
25.	Marathwada	7	3	100	1	3	-83	8	7	13
26.	Vidarbha	70	11	533	19	11	83	90	22	313
27.	Chattisgarh	54	13	315	24	14	68	78	27	185
28.	Coastal Andhra Pradesh	4	7	-37	7	9	-25	11	15	-30
29.	Telangana	37	4	726	7	6	25	44	10	328
30.	Rayalaseema	1	3	-71	11	3	232	12	7	74
31.	Tamil Nadu	3	21	-85	12	14	-17	15	35	-57
32.	Coastal Karnataka	1	2	-41	**	**	-75	1	2	-47
33.	North Interior Karnataka	9	2	357	1	3	-59	10	5	113
34.	South interior Karnataka	9	2	333	5	3	44	14	5	152
35.	Kerala	19	11	74	7	16	-58	25	27	-4
36.	Lakshadweep	18	20	-14	11	17	-33	29	37	-22

Note : ** 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 2005

S. No	System	Duration	Place of first location	Direction of movement	Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) Cyclonic storms						
1.	Cyclonic storm	13 – 17	Southern parts of southeast Bay	Westerly	Southern parts of southeast Bay and adjoining equatorial Indian Ocean	The details of the system are given in text portion
(B) Low pressure area						
1.	Well-marked low pressure area	8 – 10	Southwest Bay	Westerly	Southwest Bay and adjoining Sri Lanka	It formed under the influence of a trough of low at sea level over south Andaman Sea and adjoining southeast Bay on 3 rd which moved in a westerly direction It weakened into a trough of low on 11 th and became less marked on 12
(C) Western disturbances/eastward moving systems						
<i>(i) Upper air systems</i>						
1.	Upper air cyclonic circulation mid-tropospheric levels	6 eve – 9	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Eastern parts of Jammu & Kashmir	Moved away on 10
2.	Do	9 – 12	Central Pakistan and adjoining west Rajasthan	Do	Jammu & Kashmir and neighbourhood	Moved away on 13
3.	Do	13 – 18	North Pakistan and adjoining Jammu & Kashmir	Do	Eastern parts of Jammu & Kashmir	Moved away on 19
4.	Do	17 eve – 20	Afghanistan and adjoining Pakistan	Do	Do	Moved away on 21
5.	Do	21 – 25	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 26
6.	Do	26 – 27	North Pakistan and adjoining Jammu & Kashmir and Punjab	Do	Jammu & Kashmir and neighbourhood	Moved away on 28
7.	Do	30 Jan – 1 Feb	North Pakistan and adjoining Jammu & Kashmir	Do	Eastern parts of Jammu & Kashmir	Moved away on 2 nd February
<i>(ii) Induced lows</i>						
1.	Low pressure area	27	West Rajasthan and adjoining central Pakistan	Do	Haryana and neighbourhood	It was observed as an induced cyclonic circulation over central Pakistan and adjoining west Rajasthan on 25 It again lay as an induced cyclonic circulation over Rajasthan and neighbourhood from 28 to 31. Further, it lay as a trough over east Uttar Pradesh, extending upto mid tropospheric levels on 1 February and over Assam & Meghalaya on 2 which became less marked on 3

TABLE 2 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>(iii) Induced cyclonic circulations</i>						
1.	Mid tropospheric levels	16 – 19	West Rajasthan and neighbourhood	Northeasterly	Uttar Pradesh and neighbourhood	Moved away on 20
2.	Do	21 – 24	Central Pakistan and adjoining west Rajasthan	Southeasterly	Vidarbha and neighbourhood	Less marked on 25
3.	Do	26 – 27	West Uttar Pradesh and adjoining Uttaranchal	Northeasterly	Uttaranchal & neighbourhood	Less marked on 28
<i>(D) Other cyclonic circulations</i>						
1.	Lower levels	12	North Bay and neighbourhood	Stationary	<i>In situ</i>	Less marked on 13
2.	Mid tropospheric levels	22 – 26	Bangladesh and neighbourhood	Northeasterly	Nagaland-Manipur-Mizoram-Tripura and adjoining areas	Less marked on 27
3.	Lower levels	27 – 29	Marathwada and neighbourhood	Northeasterly	South Uttar Pradesh and adjoining Madhya Pradesh	Less marked on 30
<i>(E) Troughs in easterlies</i>						
1.	Trough of low water level	22 – 23	Southwest Bay off Sri Lanka-Tamil Nadu coast	Stationary	<i>In situ</i>	Less marked on 24
2.	Do	24 Jan – 7 Feb	Southeast Bay and adjoining south Andaman Sea	Westerly	Lakshadweep and adjoining southeast Arabian Sea	Less marked on 7 February
<i>(F) Troughs in lower level westerlies</i>						
1.	Lower levels	10 – 11	Long 90° E, north of Lat. 21° N	Stationary	<i>In situ</i>	Less marked on 12
<i>(G) Other troughs</i>						
1.	Lower levels	11	Interior Orissa to coastal Andhra Pradesh	Stationary	<i>In situ</i>	An embedded cyclonic circulation was seen over Orissa and adjoining Chattisgarh on 11 and became less marked 12
2.	Sea level	27 Jan – 1 Feb	South Tamil Nadu to south Rajasthan through interior Karnataka, Maharashtra, west Madhya Pradesh	Easterly	Coastal Tamil Nadu to Bihar through coastal Andhra Pradesh, Orissa and Jharkhand	Less marked on 2 February

pressure area over south Bay and adjoining equatorial Indian Ocean on 13 morning. It concentrated into a depression and lay centred near Lat. 5.5° N/ Long. 87.0° E at 1200 UTC of 13. Remaining practically stationary over there, it intensified into a deep depression on 14 morning and further into a cyclonic storm over the same area on 15 morning. Moving slowly westwards, it lay centred near Lat. 5.5° N / Long. 86.5° E at 0300 UTC of 16. Subsequently it drifted southwestwards, weakened into a

deep depression and lay centred at 0300 UTC of 17, near Lat. 5.0° N/ Long. 86.0° E. It further weakened into a depression over there on 17 evening, into a well marked low pressure area on 18 and lay as a low pressure area over there on 19 & 20. It moved westwards, further weakened and became less marked on 27.

Track of the system is shown in Fig. 2.

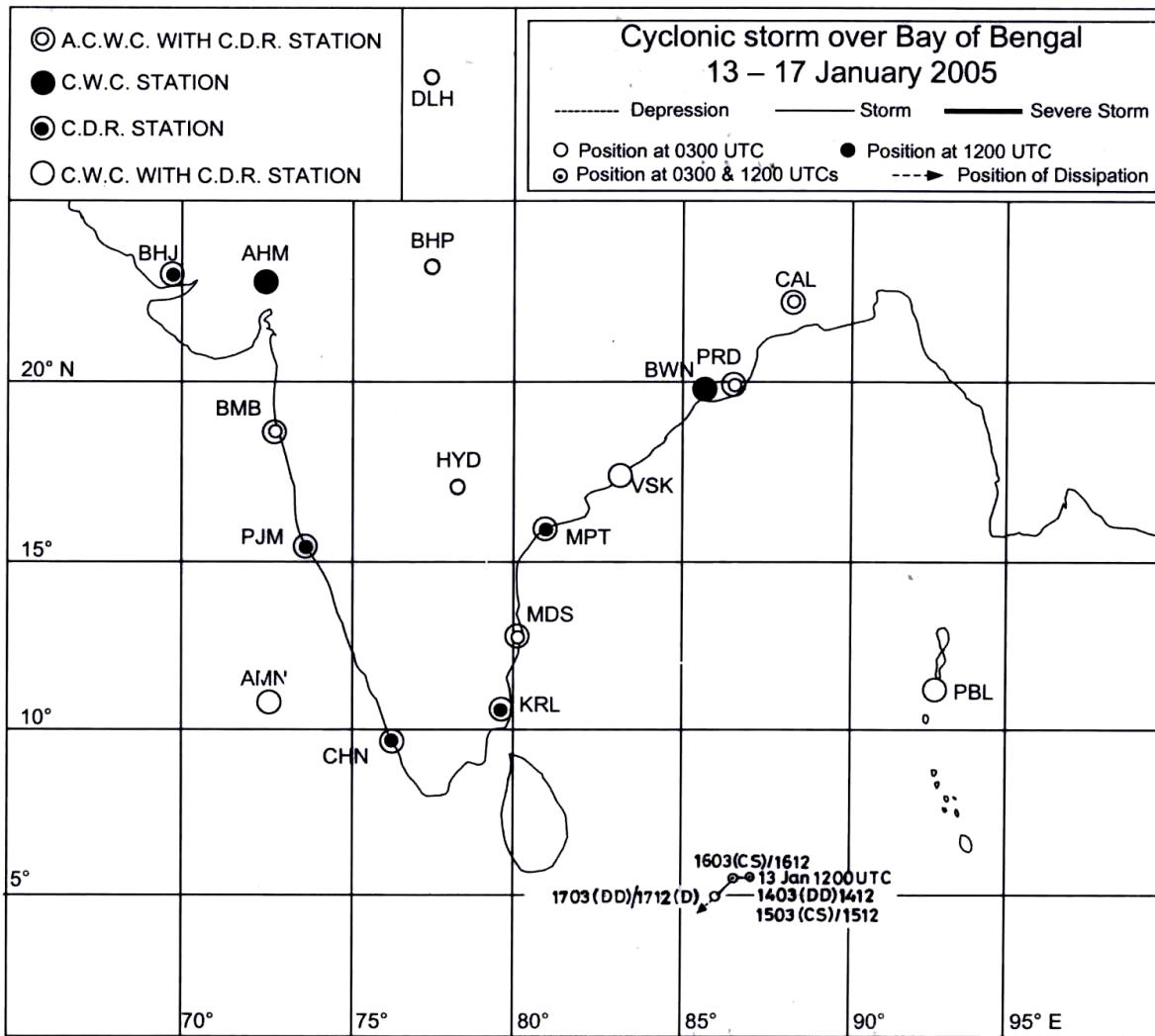


Fig. 2. Tracks of cyclonic storms over Bay of Bengal during 13-17 January 2005

3.1.1.(b). Other systems

Apart from this, there was a well marked low pressure area, 11 western disturbances (including an induced low pressure area and 3 induced upper air cyclonic circulations), 3 other upper air cyclonic circulations, 1 trough in westerlies, 2 troughs in easterlies and 2 other troughs during the month. Details of these systems are given in Table 2.

Rain/snow occurred either *at most places* or *at many places* on: 6 days in Jammu & Kashmir; 3 to 4 days in Uttaranchal and Himachal Pradesh and *at a few places* or *at isolated places* on 13 days in Himachal Pradesh and on 5 to 7 days in Uttaranchal and Jammu & Kashmir.

Rain/thundershowers also occurred either *at most places* or *at many places* on: 4 to 5 days in Jharkhand and Chattisgarh; 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, West Bengal & Sikkim, Orissa, Bihar, Uttar Pradesh, Haryana, Punjab, east Madhya Pradesh and Maharashtra & Goa States and either *at a few places* or *at isolated places* on: 9 to 12 days in Andaman & Nicobar Islands, east Uttar Pradesh, Tamil Nadu, south interior Karnataka and Kerala; on 4 to 8 days in Arunachal Pradesh, Assam & Meghalaya, West Bengal & Sikkim, Orissa, Jharkhand, west Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Madhya Maharashtra, Marathwada, coastal Andhra Pradesh, Telangana and north interior Karnataka and on 1 to 3 days in Nagaland-Manipur-Mizoram-Tripura, Bihar, Rajasthan, Konkan & Goa,

TABLE 3

Details of the weather systems during February 2005

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>(i) Upper air cyclonic circulation</i>						
1.	Mid tropospheric levels	1 – 5	North Pakistan and adjoining Jammu & Kashmir	Northeasterly	Punjab and adjoining Himachal Pradesh	Moved away on 6
2.	Do	12 – 13	Central Pakistan and adjoining northwest Rajasthan	Do	Jammu & Kashmir and neighbourhood	Moved away on 14
3.	Do	14 – 20	North Pakistan and adjoining Jammu & Kashmir	Do	Haryana and neighbourhood	Moved away on 21
4.	Do	19 – 23	North Pakistan and adjoining Jammu & Kashmir	Do	Eastern parts of Jammu & Kashmir	Moved away on 24
5.	Do	23 – 27	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 28
6.	Do	26 Feb – 2 Mar	North Pakistan and adjoining Jammu & Kashmir	Do	Do	Moved away on 3 March
<i>(ii) Induced low pressure area</i>						
1.	Low pressure area	4	Central Pakistan and adjoining west Rajasthan	Easterly	West Madhya Pradesh and adjoining south Uttar Pradesh	It was first located as an induced cyclonic circulation at mid tropospheric levels over the same area. Again on 5, it was observed as a cyclonic circulation, which became less marked on 7
2.	Low pressure area	6	Do	Stationary	<i>In situ</i>	It was first located as a cyclonic circulation on 5. Less marked on 7. However associated cyclonic circulation lay over northwest Rajasthan and neighbourhood with a trough from this system extending southwestwards upto Jharkhand through west Uttar Pradesh and neighbourhood on 8 and became less marked on 9
3.	Do	15	North Pakistan and adjoining northwest Rajasthan	Do	Do	Less marked on 16, however, associated cyclonic circulation extended upto mid tropospheric levels and lay over Haryana and neighbourhood on 16 and moved away on 17
<i>(iii) Induced cyclonic circulations</i>						
1.	Mid tropospheric levels	17 – 20	Central Pakistan and adjoining west Rajasthan	Easterly	South east Uttar Pradesh and neighbourhood	Less marked on 21
2.	Do	21 – 23	Northwest Rajasthan and neighbourhood	Do	Do	Less marked on 24
3.	Do	28 Feb – 2 Mar	South Pakistan and adjoining west Rajasthan	Do	West Madhya Pradesh and neighbourhood	Less marked on 3 March

TABLE 3 (Contd.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(B) Other cyclonic circulations						
1.	Mid tropospheric levels	8 – 13	South Pakistan and adjoining west Rajasthan	Northeasterly	Northwest Rajasthan and adjoining Punjab	Less marked on 14
2.	Lower levels	16	Northern parts of Madhya Pradesh and adjoining south Uttar Pradesh	Stationary	<i>In situ</i>	Less marked on 17
(C) Troughs in easterlies						
1.	At sea level	3 – 15	Southeast Bay	Quasi-stationary	Lakshadweep–Maldives areas and adjoining southeast Arabian Sea	Less marked on 16
2.	At sea level	7 – 20	South Andaman Sea and adjoining southeast Bay	Westerly	Maldives–Lakshadweep areas	Became unimportant on 21
3.	Do	18 – 28	Southwest Bay off Sri Lanka coast	Northwesterly	Lakshadweep and adjoining southeast Arabian Sea	Less marked on 1 March
4.	Do	27	South Andaman Sea	Westerly	Southeast Bay	It persisted in the next season
(D) Troughs in westerlies						
1.	Mid tropospheric levels	14 – 17	Sub-Himalayan West Bengal & Sikkim to northwest Bay	Stationary	<i>In situ</i>	Less marked on 18
(E) Other troughs						
1.	Wind discontinuity/trough	6 – 7	Tamil Nadu to Vidarbha through interior Karnataka and Marathwada	Stationary	<i>In situ</i>	Less marked on 8
2.	Do	18 – 28	Tamil Nadu to Nagaland-Manipur-Mizoram-Tripura	Do	Do	Persisted in the next season

Vidarbha, Chattisgarh, Rayalaseema, coastal Karnataka and Lakshadweep. *Heavy rain* occurred on one day each in Chattisgarh, Telangana, Tamil Nadu and Kerala.

3.1.2. Monthly rainfall

Monthly rainfall was *excess* in 13 Met. sub-divisions, viz., Assam & Meghalaya, Gangetic West Bengal, Orissa, Punjab, Jammu & Kashmir, east Madhya Pradesh, Marathwada, Vidarbha, Chattisgarh, Telangana, north interior Karnataka, south interior Karnataka and Kerala; *normal* in 6, viz., Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, Haryana, and Lakshadweep; *deficient* in 7, viz., east Uttar Pradesh, west Uttar Pradesh, Uttaranchal, Himachal

Pradesh, west Madhya Pradesh, coastal Andhra Pradesh, and coastal Karnataka and *scanty* in 9, viz., Andaman & Nicobar Islands, Nagaland-Manipur-Mizoram-Tripura, west Rajasthan, east Rajasthan, Gujarat region, Konkan & Goa, Madhya Maharashtra, Rayalaseema, and Tamil Nadu. There was no rain in Saurashtra & Kutch.

Sub-divisionwise percentage departure and principal amounts of rainfall for the month of January are given in Tables 1 and 4 respectively.

3.1.3. Temperature

Cold wave conditions prevailed on 1 to 3 days in some parts of Jharkhand, west Madhya Pradesh, Madhya

TABLE 4

Principal amounts of rainfall (cm) over different stations for the months of January and February 2005

Date	January	February
(1)	(2)	(3)
1	Batote 8, Banihal, Quazi Gund & Srinagar 5 each, Jammu, Kupwara & Pahalgam 4 each, Tissa & Raya 3 each, Nurpur, Sujampur, Sirsa & Tira Amritsar 2 each, Ludhiana, Bhuntar, Sri Ganganagar & Nancowry 1 each	Bhavani 11, Korba & Pattambi 5 each, Tawang, Navrangpur, Pendra & Ambikapur 3 each, Gorakhpur, Sultanpur, Kumarsain, Sankalan, Jagdalpur & Agathi 2 each, Gangtok, Tadong, Daltonganj, Mukteshwar, Bahraich, Dehragopipur, Ramagundam, Hyderabad, Sohagpur, Raichur, Chitradurga, Mandya & Amini Divi 1 each
2	Pahalgam 3, Batote, Banihal & Quazi Gund 2 each, Kumarsain, Nawashahar, Hosdurga & Tehri 1 each	Pudukottai 13, Venkatagiri 7, Arogyavaram 4, Waltair & Tondi 2 each, Kakinada, Visakhapatnam, Tawang, Bangalore & Mandya 1 each
3	Pahalgam & Quazi Gund 4 each, Batote & Banihal 2 each, Tissa, Bhuntar, Bagewadi, Srinagar & Patsio 1 each	Mancompu 5
4	K. R. Pet 6, Chickmagalur & Hubli 2 each, Tissa, Medgal, Murnad, Pantnagar, Mukteshwar & Kahu 1 each	Kavali 7, Cuddalore & Coonoor 1 each
5	Nil	Batote 2, Banihal & Quazi Gund 1 each
6	Nancowry 1	Hissar, Kupwara & Churu 2 each, Gangtok, Karnal, New Delhi, Pilani, Itanagar, Fazilka & Fatehgarh 1 each
7	Nil	Banihal 7, Batote & Katra 6 each, Kumarsain 4, Dehra Dun, Tehri, Nangal, Ropar, Bahadurgarh, Nawashahar, Sundernagar, Bangana, Kandaghat, Kahu & Shimla 3 each, Thanesar, Bhuntar, Jammu, Churu, Nizamabad, Khowang Pilani & Nagpur 2 each, Varanasi, Srinagar, Bikaner & Katangi 1 each
8	Nil	Dhundhi 10, Banihal & Batote 7 each, Solangnala & Dharamshala 6 each, Varanasi 5, Ranchi, Mukteshwar, Hissar, Bhuntar, Kahu & Solan 4 each, Jamshepur, Hindon, Tehri, Chandanpur, Ambikapur, Naraingarh, New Delhi, Ropar & Sundernagar 3 each, Gaya, Ambala, Shimla, Rewa & Churu 2 each, Amritsar, Rohtak, Jammu & Khanitar 1 each
9	Nil	Katra 4, Dharampur 3, Ghamroor, Quazi Gund & Dharamshala 2 each, Bhuntar & Ajnala 1 each
10	Kampur 5, Khowang 4, Car Nicobar & Nancowry 3 each, Passighat 2, Tezpur, Dibrugarh, Gangtok & Tezu 1 each	Gulmarg 5, Dhundhi, Bhang, Jammu & Katra 3 each, Solangnala & Nurpur 2 each, Amritsar, Kasauli, Kandaghat, Shimla, Sri Ganganagar, Johana & Suratgarh 1 each
11	Uluberia 4, Kolkata 3, Golaghat 1	Kupwara & Atrauli 3 each, Kalpa 2, Rewari, Patti, Bhuntar, Bikaner, Pilani, Biswan & Rania 1 each
12	Durgachak 5, Nancowry, Diamond Harbour, Canning Town, Jalpaiguri & Sabroom 2 each, Digha, Khowang & Bhograi 1 each	Banihal 8, Batote 6, Quazi Gund 3, Avantipur 3, Srinagar & Keylong 2 each, Jammu, Katra & Khonsa 1 each
13	Nancowry 2	Passighat 5, Gulmarg 4, Mellabazar 3, Banihal 3, Bhuntar 2, Tezpur, Dibrugarh, Ludhiana, Bikaner, Pilani, Sankalan & Samarala 1 each
14	Nil	Passighat & Sibsagar 6 each, Dibrugarh 2, Ziro 1
15	Nil	Dillighat 9, Passighat 1
16	Nil	Bharwain 9, Dhundhi 8, Nangal, Batote & Banihal 7 each, Bhoranj 6, Berthin, Barsar, Bangana, Bhang, Bhuntar, Guler, Kahu, Kasol, Sankalan, Solangnala, Shimla, Sundernagar, Solan & Quazi Gund 5 each, Dhollabazar 4, Passighat, Dibrugarh, Nawashahar & Tehri 3 each, Mukteshwar, Dehra Dun, Chhachhrauli, Chandigarh, Balachaur, Jammu & Srinagar 2 each, Sri Ganganagar 1
17	Shimla, Rampur Bushar, Kumarsain, Baikuntpur & Sagar 1 each	Silchar 9, Khonsa 3, Imphal, Kailashahar & Deoband 2 each, Batote, Jagraon, Sankalan & Passighat 1 each

TABLE 4 (Contd.)

(1)	(2)	(3)
18	T. P. Barrage, Mohanpur, Mukteshwar & Shimla 3 each, Sriniketan, Bahraich, Tehri, Solan, Sunni Bhajji & Burdhan 2 each, Durgapur, Daltonganj, Sultanpur, Bareilly, Dehra Dun, Bhuntar, Ambikapur & Pendra 1 each	Kailashahar 13, Avantipur 9, Hamirpur 6, Silchar, Batote, Banihal, Quazi Gund & Matizuri 4 each, Padampur 3, Tehri, Batala & Jammu 2 each, Agartala, Bareilly, Mukteshwar, Srinagar, Sri Ganganagar & Passighat 1 each
19	T. P. Barrage & Suri 3 each, Cooch Behar 2, Gheropara, Sriniketan, Midnapore, Roing & Gossaigaon 1 each	Banihal 12, Quazi Gund 10, Srinagar & Avantipura 7 each, Udampur 6, Bangana & Malakpur 4 each, Jammu 3, Khonsa, Rampur, Bushar & Dharamshala 2 each, Patiala, Nangal, Una, Kupwara & Amroha 1 each
20	Tezu & Dibrugarh 2 each	Banihal 10, Dharamshala 8, Jamsolaghat, Nangal & Berhampore 4 each, Sitapur 3, Panagarh, Sundernagar, Dhundhi & Khonsa 1 each
21	Hut Bay, Roing & Pamban 1 each	Bankura 4, Dibrugarh & Passighat 2 each
22	Bhang, Dhundhi & Solangnala 5 each, Kumarsain, Batote & Jammu 4 each, Roing, Baijnath, Quazi Gund & Tuni 3 each, Bhuntar, Sundernagar, Banihal, Katra, Nurpur & Ziro 2 each, Tehri, Shimla, Srinagar, Waltair & Pamban 1 each	Varkala 4, Dehri & Bankura 2 each, Patna & Ranchi 1 each
23	Ajnala 4, Amritsar, Baijnath, Minicoy, Jammu & Katra 3 each, Dehra Dun, Tehri, Ambala, Chandigarh, Karnal, Ludhiana, Bhuntar, Shimla, Sundernagar, Una & Batote 2 each, Bihubar & Jabalpur 1 each	Patna, Tuticorin & Punalur 1 each
24	Gangtok, Bahraich, Shimla & Kangra 2 each, Dibrugarh, Guwahati, Tadong, Passighat, Jalpaiguri, Patna, Muzaffarpur, Nalgonda & Kurnool 1 each	Kupwara & Idukki 1 each
25	Nil	Seppa & Kupwara 1 each
26	Hyderabad 2, Visakhapatnam 1	Seppa 2, Khowang 1
27	Gopalpur 4, Ramagundam & Chandrapur 3 each, Jagdalpur & Billoli 2 each, Raipur, Akola, Nizamabad, Phulbani & Multai 1 each	Roing 2, Chouldhowaghat 1
28	Ambagarh 11, Reva & Chandrapur 5 each, Ajnala 4, Jind, Kaithal, Amritsar, Ludhiana, Gurdaspur, Pantnagar, Bangana, Dhundhi & Batote 3 each, Chhachhrauli, Kamal, Ambala, Una, Shimla, Deoband, Mirzapur, Sundernagar, Banihal, Jammu, Katra, Kollam, Doda, Jabalpur & Raipur 2 each, Jharsuguda, Varanasi, Tehri, Dehra Dun, Hissar, Chandigarh, Satna & Kochi 1 each	Sankalan 4, Gangtok, Kupwara, Buldhana & Mahabaleshwar 1 each
29	Bhoranj, Dongargarh & Chandbali 4 each, Cuttack & Alapuzha 3 each, Keonjargarh, Jamshedpur, Raipur, Bankura, Balasore & Hyderabad 2 each, Kolkata, Diamond Harbour, Bhubaneswar, Paradip, Balasore, Gopalpur, Jharsuguda, Ranchi, Mukteshwar, Bhang, Yeotmal, Dhundhi & Adilabad 1 each	—
30	Kochi & Kembhavi 7 each, Nagpur 5, Bolangir & Ambagarh 4 each, Karipur 3, Raipur, Kozhikode, Punalur & Balaghat 2 each, Pendra, Nizamabad, Tuticorin, Multai, Chopda & Bhira 1 each	—
31	Adilabad 12, Kodaikanal 8, Pali & Sohagpur 6 each, Quazi Gund & Paravur 5 each, Pendra, Valaparai & Billoli 4 each, Bidar, Dhundhi, Jabalpur & Ambikapur 3 each, Patsio, Banihal, Raipur, Akola, Parbhani, Coonoor & Kochi 2 each, Solangnala, Gondia, Bhira, Pune, Jalgaon, Nizamabad & Sonapur 1 each	—

Maharashtra, Marathwada and Vidarbha. *Cold day conditions* prevailed on 4 to 5 days in some parts of Haryana and Punjab and on 2 to 3 days in Uttaranchal and Rajasthan.

Night temperatures were *appreciably to markedly below normal* in some parts of: Punjab on 15 days; Jharkhand, Uttaranchal, Rajasthan, Gujarat Region, Madhya Maharashtra and Vidarbha on 7 to 9 days; Haryana, Himachal Pradesh and Madhya Pradesh on 4 to 6 days and Orissa, Bihar, west Uttar Pradesh, Jammu & Kashmir, Saurashtra & Kutch, Konkan & Goa, Chattisgarh, Telangana, Rayalaseema, Tamil Nadu and interior Karnataka on 1 to 3 days. They were *below normal* in some parts of Orissa, Bihar, east Uttar Pradesh, Punjab, Rajasthan, Konkan & Goa and Tamil Nadu on 8 to 10 days; Jharkhand, west Uttar Pradesh, Haryana, Madhya Pradesh, Gujarat State, Madhya Maharashtra, Chattisgarh, coastal & south interior Karnataka on 4 to 7 days and Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Uttaranchal, Himachal Pradesh, Jammu & Kashmir, Marathwada, Vidarbha, Andhra Pradesh, north interior Karnataka and Kerala on 1 to 3 days. They were *appreciably to markedly above normal* in some parts of coastal Andhra Pradesh on 16 days; Nagaland-Manipur-Mizoram-Tripura, east Uttar Pradesh, Rajasthan, east Madhya Pradesh, Madhya Maharashtra, Marathwada, Chattisgarh, Telangana and Rayalaseema on 8 to 12 days; Assam & Meghalaya, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, west Uttar Pradesh, Uttaranchal, Haryana, Himachal Pradesh, west Madhya Pradesh, Gujarat State, Vidarbha, Tamil Nadu, south interior Karnataka and Kerala on 4 to 7 days and Punjab, Jammu & Kashmir and north interior Karnataka on 1 to 3 days. They were *above normal* in some parts of Orissa, west Rajasthan, Madhya Maharashtra, coastal Andhra Pradesh and Kerala on 8 to 12 days; Assam & Meghalaya, Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, Jammu & Kashmir, east Rajasthan, Madhya Pradesh, Gujarat State, Marathwada, Chattisgarh, Telangana, Rayalaseema, Tamil Nadu, coastal & south interior Karnataka on 4 to 7 days and Gangetic West Bengal, west Uttar Pradesh, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Konkan & Goa and Vidarbha on 1 to 3 days.

The month's and the season's lowest minimum temperature over the plains was 0° C recorded at Amritsar(Punjab) on 6 & 18 of January 2005.

3.1.4. *Disastrous weather events and damage*

According to media reports: *Cold wave* claimed the lives of 10 people in West Bengal and 3 people lost their

lives in Uttaranchal due to landslide triggered by snowfall. Hail storm and heavy rains damaged crops over many parts of the country. Train services were disrupted in parts of North India due to fog. Also most of the hill stations in northwest India remained cutoff as major roads were blocked due to heavy snowfall.

3.2. *February*

3.2.1. *Weather and associated synoptic features*

There were 12 western disturbances (including 3 induced low pressure areas and 3 induced upper air cyclonic circulations), 2 other cyclonic circulations, a trough in the westerlies, 4 troughs in the easterlies and 2 troughs /wind discontinuity which affected the weather in India during the month of February. Details of these systems are given in Table 3.

Heavy rain/snow occurred on two days each in Himachal Pradesh and Jammu & Kashmir. Rain/snow occurred either *at most places* or *at many places* on 10 to 11 days in Himachal Pradesh and Jammu & Kashmir and on 4 days in Uttaranchal. It occurred either *at a few places* or *at isolated places* on 10 to 14 days in Uttaranchal, Himachal Pradesh and Jammu & Kashmir.

Very heavy rain occurred on one day each in Nagaland-Manipur-Mizoram-Tripura and Tamil Nadu. *Heavy rain* also occurred on 1 to 2 days in Assam & Meghalaya, Punjab, coastal Andhra Pradesh and Tamil Nadu. Rain or thundershowers occurred either *at most places* or *at many places* on 6 to 7 days in Arunachal Pradesh and Punjab and on 1 to 3 days in Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Jharkhand, Bihar, east Uttar Pradesh, Haryana, Marathwada, Vidarbha, Chattisgarh, Telangana and Lakshadweep. It occurred either *at a few places* or *at isolated places* on: 16 to 17 days in Arunachal Pradesh, Assam & Meghalaya and Sub-Himalayan West Bengal & Sikkim; on 8 to 11 days in Gangetic West Bengal, Bihar, east Uttar Pradesh, Haryana, Punjab, West Rajasthan, Tamil Nadu and Kerala; on 4 to 7 days in Nagaland-Manipur-Mizoram-Tripura, Orissa, west Uttar Pradesh, east Rajasthan, coastal Andhra Pradesh, Rayalaseema and south interior Karnataka and on 1 to 3 days in Jharkhand, Madhya Pradesh, Maharashtra & Goa States, Chattisgarh and Telangana.

3.2.2. *Monthly rainfall*

Monthly rainfall was *excess* in 15 meteorological sub-divisions *viz.*, Arunachal Pradesh, Assam & Meghalaya, Jharkhand, Bihar, Uttaranchal, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, west

Rajasthan, Vidarbha, Chattisgarh, Telangana, Rayalaseema and south interior Karnataka; *normal* in 5, viz., Nagaland-Manipur-Mizoram-Tripura, Sub-Himalayan West Bengal & Sikkim, east Uttar Pradesh, west Uttar Pradesh and Tamil Nadu; *deficient* in 7 viz., Gangetic West Bengal, east Rajasthan, east Madhya Pradesh, coastal Andhra Pradesh, north interior Karnataka, Kerala and Lakshadweep and *scanty* in 6 viz., Orissa, west Madhya Pradesh, Konkan & Goa, Madhya Maharashtra, Marathwada and coastal Karnataka. There was no rain in the remaining 3 sub-divisions viz., Andaman & Nicobar Islands, Gujarat region and Saurashtra & Kutch.

Sub-divisionwise percentage departure and principal amounts of rainfall for the month of February are given in Tables 1 and 4 respectively.

3.2.3. Temperature

Severe Cold wave conditions prevailed in some parts of Rajasthan and Gujarat State on 2 to 3 days; *Cold wave conditions* prevailed in some parts of Rajasthan, west Madhya Pradesh, and Gujarat Region on 4 to 5 days; Orissa, Haryana, Punjab east Madhya Pradesh, Saurashtra & Kutch and Madhya Maharashtra on 1 to 2 days and *Cold day conditions* prevailed in parts of Konkan & Goa on 3 days.

Night temperatures were *appreciably to markedly below normal* in some parts of: west Uttar Pradesh, Uttaranchal, Rajasthan, Madhya Pradesh, Gujarat State, Madhya Maharashtra, Tamil Nadu and south interior Karnataka on 4 to 8 days and Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Orissa, Jharkhand, Bihar, east Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Konkan & Goa, Marathwada, Vidarbha, Chattisgarh, Telangana, Rayalaseema, coastal & north interior Karnataka and Kerala on 1 to 3 days. They were *below normal* in some parts of Madhya Maharashtra, Tamil Nadu, coastal & south interior Karnataka on 7 to 10 days: Jharkhand, east Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, east Rajasthan, Madhya Pradesh, Gujarat State, coastal Andhra Pradesh and Rayalaseema on 4 to 6 days and Nagaland-Manipur-Mizoram-Tripura, Orissa, Bihar, west Uttar Pradesh, Uttaranchal, Jammu & Kashmir, west Rajasthan, Konkan & Goa, Marathwada, Vidarbha, Chattisgarh, Telangana and Kerala on 1 to 3 days. They were *above normal* in parts of Assam & Meghalaya, Madhya Maharashtra, coastal Andhra Pradesh and Tamil Nadu on 8 to 12 days; Nagaland-Manipur-Mizoram-Tripura, Gangetic West Bengal, Orissa, Jharkhand, west Uttar Pradesh, Uttaranchal, Jammu & Kashmir, Konkan & Goa, Vidarbha, Chattisgarh, Telangana, Rayalaseema, south interior Karnataka and Kerala on 4 to 7 days and Sub-

Himalayan West Bengal & Sikkim, Bihar east Uttar Pradesh, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, Gujarat region, Marathwada, coastal & north interior Karnataka on 1 to 3 days and *appreciably to markedly above normal* in parts of Nagaland-Manipur-Mizoram-Tripura, West Bengal & Sikkim, Orissa, Bihar, east Uttar Pradesh, Haryana, Rajasthan, Madhya Pradesh, Gujarat State and Chattisgarh on 12 to 17 days; Assam & Meghalaya, Jharkhand and Marathwada on 8 to 11 days; west Uttar Pradesh Uttaranchal, Punjab, Jammu & Kashmir, Madhya Maharashtra, Vidarbha and Andhra Pradesh on 4 to 7 days and Arunachal Pradesh, Himachal Pradesh, Konkan & Goa, Tamil Nadu and south interior Karnataka on 1 to 3 days.

During the month, the lowest minimum temperature of 0.7° C over the plains was recorded at Ludhiana (Punjab) on 6 February 2005.

3.2.4. Disastrous weather events and damage

More than 200 people lost their lives in Jammu & Kashmir due to snow and Avalanches. The heavy snowfall, unprecedented of its kind in the past 15 years disrupted road, rail transport and all means of communications and also more than 300 people were reported to be missing. Lightning and hailstorm claimed the lives of 2 people in Madhya Pradesh and one in Vidarbha. It also damaged standing crops in Vidarbha and West Bengal. Heavy rain and landslide claimed two lives in Kerala and disrupted road transport as well.

Appendix

Definitions of the terms given in 'Italics'

Rainfall

<i>Excess</i>	- percentage departure from normal rainfall is + 20% or more.
<i>Normal</i>	- percentage departure from normal rainfall is from -19 % to + 19 %.
<i>Deficient</i>	- percentage departure from normal rainfall is from -20 % to -59 %.
<i>Scanty</i>	- percentage departure from normal rainfall is from -60 % to -99 %.
<i>At most places</i>	- 75 % or more stations of a meteorological sub-division reporting at least 2.5 mm rainfall.
<i>At many places</i>	- 51% to 74 % 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.

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

Very heavy rain - rainfall amount 12.5 cm or more.

Temperature

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 should be used and when it is $\leq 10^{\circ}$ C only, cold wave should be considered (this criteria does not hold for coastal stations).

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

Cold wave conditions - departure WCTn from normal minimum temperature is from -5° C to -6° C where normal

minimum temperature $\geq 10^{\circ}$ C and -4° C to -5° C elsewhere.

Also cold wave is declared when WCTn is $\leq 0^{\circ}$ C irrespective of the normal minimum temperature for those stations

Cold day - when maximum temperature is $\leq 16^{\circ}$ C in 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 -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 $+5^{\circ}$ C to $+6^{\circ}$ C.

Appreciably above normal - departure of minimum temperature from normal is from $+3^{\circ}$ C to $+4^{\circ}$ C.

Above normal - departure of minimum temperature from normal is $+2^{\circ}$ C.