

Weather

WINTER SEASON (JANUARY-FEBRUARY 1991)*

1. Introduction

During the winter season the precipitation mainly occurs in the hilly regions of north India and in Andaman & Nicobar Islands.

The short-term and long-term rainfall distributions are described using the following norms adopted by the India Meteorological Department.

Norm	Percentage departure from normal
Excess	: +20 per cent and above
Normal	: +19 to -19 per cent
Deficient	: -20 to -59 per cent
Scanty	: -60 per cent or less

Monthwise synoptic features are given in Tables 1 and 2. Table 3 contains the monthly and seasonal rainfall figures.

2. Chief features

- (i) Occurrence of snowfall over western Himalayas in January and February and in Arunachal Pradesh in January.
- (ii) Prevalence of cold wave conditions in several parts of north India.
- (iii) Days were abnormally cold in several parts of northwest India during the first week of January.
- (iv) Occurrence of hailstorms in Assam during January and February and in Rajasthan during February.

3. Season's rainfall

The season's rainfall was in excess in Jammu & Kashmir; normal in Assam & Meghalaya, West Bengal & Sikkim, Orissa, Punjab, Himachal Pradesh, coastal Andhra Pradesh and Telangana; deficient in Bihar, Uttar Pradesh, Haryana, west Rajasthan, east Madhya Pradesh, Vidarbha, Tamil Nadu, Kerala and Lakshadweep and scanty in Andaman & Nicobar Islands, Arunachal Pradesh, east Rajasthan, west Madhya Pradesh, Saurashtra & Kutch, Madhya Maharashtra, Marathwada, Rayalaseema and interior Karnataka.

The weather was dry over Gujarat region, Konkan & Goa and coastal Karnataka during the season.

Monthly and seasonal rainfall figures for the 35 meteorological sub-divisions of India are given in Table 3 and seasonal rainfall departures in Fig. 1.

4. January

4.1. Weather and associated synoptic features

The details of the synoptic features of the month are given in Table 1. Northwest India was affected by six western disturbances during the month. However, none of these western disturbances caused widespread precipitation over western Himalayas except on 1st, when Himachal Pradesh received rainfall at many places. Rain/thundershowers occurred either almost at all the places or at many places on 1 to 3 days in Arunachal Pradesh, Assam & Meghalaya, West Bengal & Sikkim, Orissa and in Bihar plains between 1st and 4th and on 1 to 2 days in Gangetic West Bengal, Bihar and east Madhya Pradesh between 9th and 13th. They occurred at a few places or at one or two places on 9 to 12 days in Andaman & Nicobar Islands, Orissa, Himachal Pradesh, east Madhya Pradesh, coastal Andhra Pradesh and Tamil Nadu, on 5 to 8 days in Assam & Meghalaya, Gangetic West Bengal, Bihar Plateau, Vidarbha and Kerala and on 1 to 4 days over the rest of the country outside Haryana, Punjab, Gujarat, Konkan and Goa, Madhya Maharashtra and coastal Karnataka where mainly dry weather prevailed during the month.

There were three spells of snowfall over western Himalayas during this month. In the first spell rain or snow occurred at a few places in hills of west Uttar Pradesh from 6th to 9th. Also light snowfall reported on 2 days over Jammu & Kashmir during the same period. During the second spell between 11th and 15th it occurred at one or two places on 1 or 2 days over hills of west Uttar Pradesh and Jammu & Kashmir and during the third spell between 25th & 29th it occurred at a few places on 3 days in Jammu & Kashmir. Heavy snowfall was reported at one or two places in hills of west Uttar Pradesh during the first spell.

* Compiled by : S/Shri G. R. Gupta, D. S. Desai and N. C. Biswas, Meteorological office, Pune

4.2. Rainfall

Month's rainfall was in excess in 6, normal in 5, deficient in 5 and scanty in 14 meteorological sub-divisions. There was no rain in 5 sub-divisions.

Rainfall was in excess in Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Orissa, coastal Andhra Pradesh and Telangana; normal in Bihar, east Madhya Pradesh, Tamil Nadu and Kerala; deficient in Arunachal Pradesh, Assam & Meghalaya, east Uttar Pradesh, Vidarbha and Lakshadweep and scanty in Andaman & Nicobar Islands, west Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan, west Madhya Pradesh, Marathwada, Rayalaseema and interior Karnataka. There was no rain in Gujarat, Konkan & Goa, Madhya Maharashtra and coastal Karnataka.

The significant amounts of rainfall (cm) are given below :

- 1st : Sattenpalli 10, Mattupalayam 8, Hanam, konda & Periyakulam 7 each, Karimnagar & Konni 5 each, Makthal, Muzaffarpur & Parli 3 each.
- 2nd : Periyakulam 6, Alipingal, Bhubaneswar AP, Gopalpur & Uluberia 5 each, Bankura & Prathipadu 4 each, Dummagadam 3.
- 3rd : Aryankavu & Madurai AP 7 each, Paradip 6, Salem 5, Kalimpong & Prathipadu 4 each, Gangtok & Madurai 3 each.
- 4th : Aryankavu 19, Usilampatti 6, Pondicherry 5, Tondi 3.
- 5th : Periyakulam 9, Kundukur 6, Coonoor 4.
- 6th : Mussorrie 5, Nellore 3.
- 8th : Uttarkashi 6, Banda 4, Fatehpur 3.
- 9th : Uttarkashi 7.
- 10th : Jharsuguda AP & Katghora 4 each, Deogar, Nagpur, Raigarh & Tensa 3 each.
- 11th : Rohru 4.
- 12th : Jashpurnagar 5, Ambikapur 3.
- 15th : Munsyari 3.
- 18th : Ramnathapuram & Tondi 9 each, Pamban 7, Tuticorin 3.
- 19th : Mannargudi 8, Balod 6, Kumbakonam & Tondi 5 each, Gondia 3.
- 20th : Nadumangad 4.
- 21st : Visakhapatnam AP 4.

4.3. Temperature

Cold wave conditions prevailed in Uttar Pradesh and Jammu & Kashmir on most days of the month and were severe on several days. Cold wave conditions also prevailed on 2 to 4 days in Bihar Plateau, Rajasthan, west Madhya Pradesh, Gujarat, Maharashtra, Telangana and north interior Karnataka during the first week of the month. They were severe on a couple of days in Rajasthan, west Madhya Pradesh, Konkan & Goa, Madhya Maharashtra and north interior Karnataka.

Night temperature were appreciably below normal in Bihar Plateau from 16th to 24th, in Nagaland, Manipur, Mizoram & Tripura from 21st to 26th and in Assam & Meghalaya from 22nd to 27th. They were appreciably to markedly above normal on most of the days in Haryana, Punjab, Himachal Pradesh, Rajasthan and Gujarat during the last week and in Telangana between 6th and 22nd of the month.

Lowest night temperature in the hills was recorded at Srinagar and over the plains in Amritsar, Jhalwar and Sikar. The mercury dipped to -12°C (dep. -10°C) at Srinagar on 20th. It was -1°C (dep. -7°C) at Sikar on 1st, 2nd and 3rd and was also -1°C (dep. -10°C) at Jhalwar on 2nd and at Amritsar (dep. -5°C) on 5th. Mount Abu in east Rajasthan recorded a night minimum of -6°C (dep. -16°C) on 1st. On 2nd, the minimum temperature at Pune touched 2.8°C mark (dep. -8°C), which was the lowest value recorded in the last two decades. Earlier, on 18 January 1968 Pune recorded a minimum temperature of 2.7°C . The ever recorded lowest value was 1.7°C , which the city experienced on 17 January 1935.

During the first three days of the month the days were abnormally cold in several places of north India. Day temperatures were 7°C to 8°C below normal at several places in Haryana, Punjab, Himachal Pradesh, Rajasthan, Madhya Pradesh and Gujarat on 1st, and were 7°C to 10°C below normal in Manipur, Sub-Himalayan, West Bengal & Sikkim, Uttar Pradesh, Punjab, Rajasthan, Madhya Pradesh, Gujarat and Maharashtra on 2nd and in Assam, Tripura, Manipur, Madhya Pradesh, Gujarat and Maharashtra on 3rd.

Some of the low values of day temperature are given below :

Date (Jan. 1991)	Station	Day temp. ($^{\circ}\text{C}$)	Dep. from normal ($^{\circ}\text{C}$)
1	Shimla	1	-8
	Dalhousie	6	-10
	Ambala	13	-8
	Ludhiana	13	-8
	Patiala	13	-8
2	Bhopal	17	-8
	Gangtok	7	-7
	Sikar	14	-8
	Bareilly	15	-7
	Cooch Behar	15	-9
3	Buldhana	17	-10
	Imphal	14	-7
	Jaisalmer	14	-10
	Tezpur	16	-8
	Bhopal	17	-8

4.4. Disastrous weather events and damages

As per media reports severe cold wave conditions in Rajasthan during the 1st and 3rd weeks of January claimed 9 lives in the State and caused extensive damage to crops.

Snowfall during the first week in Kashmir and in Tawang and neighbourhood of Arunachal Pradesh affected normal life. In Kashmir valley, power, water

TABLE I

Details of weather systems during January 1991

S. No.	Weather system	Period (Dates)	Place of first location	Direction of movement	Place of dissipation	Remarks
<i>(A) Western disturbances</i>						
1*	Upper air system	1-2	Himachal Pradesh & adjoining Jammu & Kashmir	Easterly	Moved away eastwards	*Located over north-east Afghanistan and neighbourhood on 27th
2	Do.	4-7 even.	North Pakistan & Neighbourhood	Do.	Moved away across Himachal Pradesh and neighbourhood	
3	Do.	7-9	Do.	Do.	Moved away across Jammu & Kashmir and neighbourhood	
4	Do.	10-12	Do.	Do.	Do.	
5	Do.	16-19	North Pakistan & adjoining Afghanistan	Do.	Do.	
6	Do.	25-30	North Pakistan & neighbourhood	Do.	Do.	
<i>(B) Induced cyclonic circulation</i>						
1	Lower tropos. levels	7-10 even.	North Madhya Maharashtra and adjoining West Madhya Pradesh	ENE'ly	Bihar plains	
2	Lower levels	24-26	West Rajasthan	NE'ly	Himachal Pradesh and neighbourhood	
<i>(C) Trough in westerlies</i>						
1	Lower tropos. levels	3-4 even.	From Bihar plains to south coastal Andhra Pradesh	Easterly	West Bengal & Sikkim and neighbourhood	
2	Lower levels	11-13 even.	From northwest Rajasthan to Konkan	Do.	Orissa & Andhra Pradesh	
<i>(D) Trough in easterlies</i>						
1	Lower levels	4-6	From Sri Lanka coast to south interior Karnataka	Westerly	Off Maharashtra-Goa-Karnataka coast	
2	Do.	16-22	Over Sri Lanka & south Tamil Nadu	Do.	Southwest Arabian Sea	
3	Do.	19-24	Southwest Bay off Sri Lanka Tamil Nadu coasts	Do.	Maldivo-Comorin area and Kerala coasts	

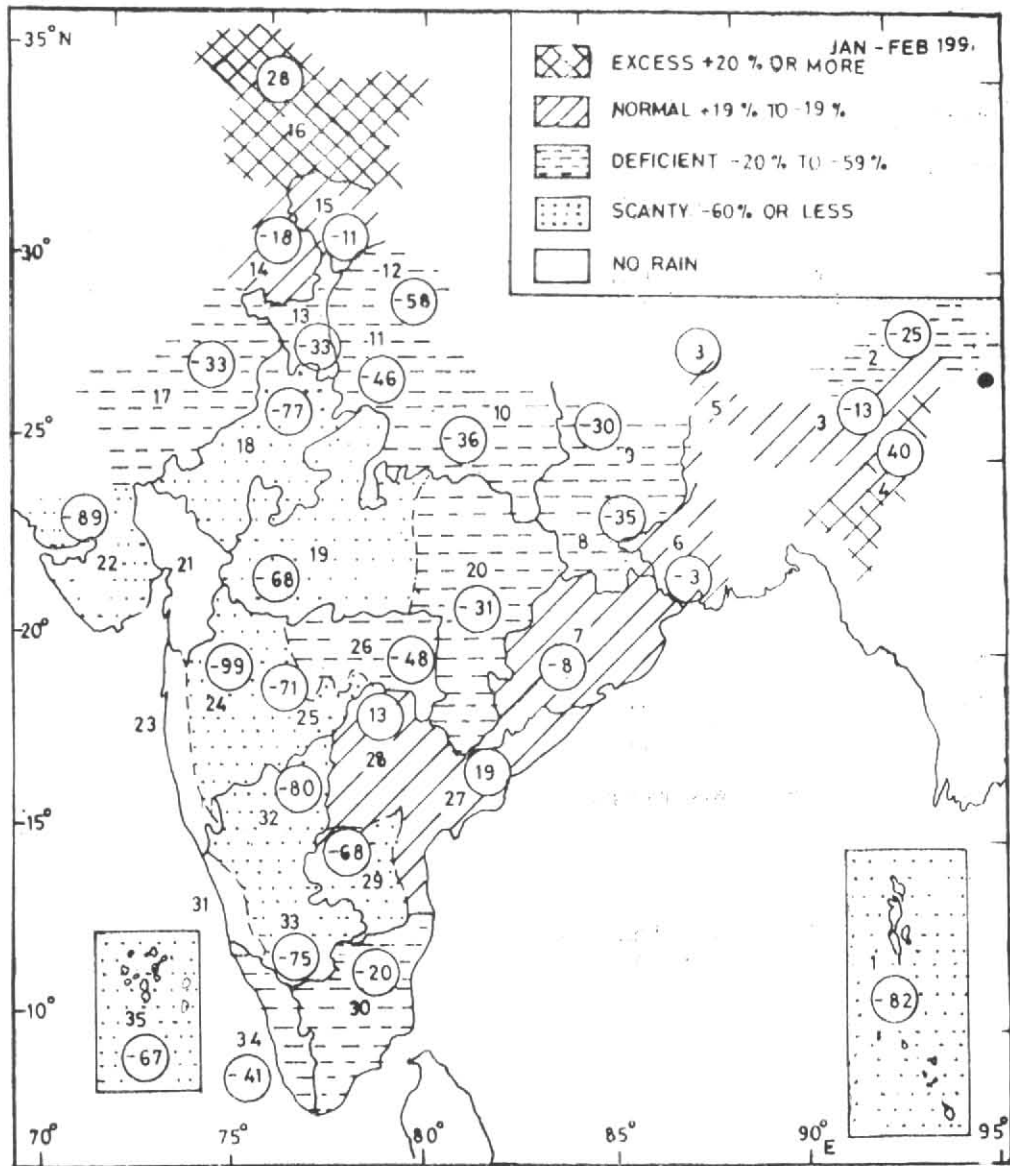


Fig. 1. Rainfall for the period 1st January to 28 February 1991. (Figures in circle indicate rainfall percentage departure from normal)

TABLE 2

Details of weather systems during February 1991

S. No.	Weather system	Period (Dates)	Place of first location	Direction of movement	Place of dissipation	Remarks
<i>(A) Western disturbance</i>						
1	Upper air system	3-5	North Pakistan & neighbourhood	Easterly	Moved away across J & K and neighbourhood	
2	Do.	5-9	Northeast Afghanistan and north Pakistan	Do.	Do.	
3	Do.	9-11 even.	Do.	Do.	Do.	
4	Do.	13-18 even.	North Pakistan and adjoining Afghanistan	Do.	Do.	Seen as a low pressure area over north Pakistan and neighbourhood up to 14th
5	Do.	20-23	North Pakistan & neighbourhood	Do.	Do.	
6	Do.	23-27	East Afghanistan & adjoining north Pakistan	Do.	Do.	
7	Do.	27 - 1 Feb Mar even.	Do.	Do.	Do.	
<i>(B) Induced cyclonic circulation</i>						
1	Lower tropos. levels	6-8th even.	Central Pakistan	ENE'ly	Punjab and neighbourhood	
2	Do.	9-11 even.	Northwest Rajasthan and adjoining Pakistan	Do.	Punjab and Haryana	
3	Do.	17-19th even.	Punjab and neighbourhood	Do.	Himachal Pradesh and neighbourhood	
4	Do.	23-25	Southwest Rajasthan and neighbourhood	Easterly	Northwest Madhya Pradesh and neighbourhood	
5	Lower levels	25-28	Southwest Rajasthan	Do.	Plains of west Uttar Pradesh	
<i>(C) Trough in westerlies</i>						
1	Lower levels	2-4 even.	From Bihar plains to Vidarbha	Easterly	Gangetic West Bengal, Orissa and coastal Andhra Pradesh	
2	Middle & upper tropospheric levels	16-18	Along Long. 65° E north of Lat. 20°N	Do.	Northwest India	
3	Do.	25-27	From North Afghanistan to south Pakistan	Do.	Roughly along Long. 76° E North of Lat. 15° N	
<i>(D) Trough in easterlies</i>						
1	Lower levels	1-5	Southwest Bay off Sri Lanka-Tamil Nadu coasts	Westerly	South interior Karnataka and neighbourhood	
<i>(E) Other cyclonic circulation</i>						
1	Lower levels	27-28	South Tamil Nadu and neighbourhood	Do.	<i>In situ</i>	

TABLE 3

Monthly & seasonal rainfall figures for winter season 1991 (January & February 1991)

S. No.	Sub-divisions	January			February			Jan + Feb		
		Actual (mm)	Normal (mm)	% Dep	Actual (mm)	Normal (mm)	% Dep	Actual (mm)	Normal (mm)	% Dep
1	Andaman & Nicobar Islands	15	72	-79	7	47	-87	22	119	-79
2	Arunachal Pradesh	17	40	-57	56	59	-4	74	99	-25
3	Assam & Meghalaya	13	21	-36	33	33	2	47	54	-13
4	Naga., Mani., Mizo. & Tripura	20	15	37	39	28	43	60	43	40
5	S.H.W.B. & Sikkim	31	18	71	11	23	54	41	40	3
6	Gangetic West Bengal	24	14	67	12	22	-47	35	36	-3
7	Orissa	32	13	155	4	26	-84	36	39	-8
8	Bihar plateau	23	20	15	7	26	-73	30	46	-35
9	Bihar plains	16	16	0	5	14	-64	21	30	-30
10	East Uttar Pradesh	11	18	-37	10	16	-37	21	33	-36
11	Plains of west Uttar Pradesh	5	22	-76	17	19	-15	22	41	-46
12	Hills of west Uttar Pradesh	19	58	-67	35	70	-50	54	128	-58
13	Haryana, Chandigarh & Delhi	0	22	-99	28	20	38	28	42	-33
14	Punjab	0	29	-99	45	26	73	45	55	-18
15	Himachal Pradesh	13	75	-82	119	72	65	132	148	-11
16	Jammu & Kashmir	13	63	-79	147	62	137	160	125	28
17	West Rajasthan	1	4	-83	5	5	-4	6	9	-33
18	East Rajasthan	0	7	-94	3	6	-47	3	13	-77
19	West Madhya Pradesh	1	14	-96	6	8	-21	7	22	-68
20	East Madhya Pradesh	19	20	-1	9	22	-60	29	42	-31
21	Gujarat Reg., Daman, Dadra & Nagar Haveli	0	2	-100	0	1	-100	0	3	-100
22	Saurashtra, Kutch & Diu	0	1	-100	0	1	-70	0	2	-89
23	Konkan & Goa	0	1	-100	0	1	-100	0	2	-100
24	Madhya Maharashtra	0	5	-100	0	2	-98	0	7	-99
25	Marathwada	1	3	-78	1	3	-71	2	7	-71
26	Vidarbha	9	11	-24	2	10	-78	11	21	-48
27	Coastal Andhra Pradesh	18	10	90	19	21	-10	37	31	19
28	Telangana	9	4	104	9	11	-22	18	16	13
29	Rayalaseema	3	9	-62	3	13	-75	7	22	-68
30	Tamil Nadu & Pondichery	34	33	1	6	16	-63	39	49	-20
31	Coastal Karnataka	0	2	-100	0	1	-100	0	3	-100
32	North Interior Karnataka	1	2	-62	0	3	-100	1	5	-80
33	South Interior Karnataka	1	3	-64	1	4	-84	2	8	-75
34	Kerala	14	14	-4	6	19	-69	20	34	-41
35	Lakshadweep	12	25	-52	1	15	-94	13	40	-67

and communication links were disrupted. Srinagar—Jammu of Hindustan-Tibet National Highway remained closed for the traffic throughout the 1st week following landslides and snowfall.

Shillong witnessed thick layer of frost over hill slopes and meadows on 7th. Hailstorm followed by heavy rains occurred in the late morning of 3rd in Tezpur and neighbourhood causing damage to the standing crops.

5. February

5.1. Weather and associated synoptic features

The details of the synoptic features of the month are given in Table 2.

The western disturbances caused three spells of snowfall in Himachal Pradesh and Jammu & Kashmir, *i.e.*, between 6th and 7th, on 12th and on 28th. Heavy snowfall was reported over Himachal Pradesh on 12th. Rain or thundershowers occurred almost at all the places or at many places on 2 days each in Haryana, Punjab, Himachal Pradesh and Jammu & Kashmir between 10th and 12th and on 1 to 3 days in Sub-Himalayan, West Bengal & Sikkim, plains of Uttar Pradesh, Haryana, Punjab, Himachal Pradesh and east Madhya Pradesh between 24th and 27th. Rain or thundershowers occurred at a few places or at one or two places on 9 to 13 days in Arunachal Pradesh, Assam & Meghalaya and Tamil Nadu; on 4 to 8 days in Andaman & Nicobar Islands, Nagaland, Manipur, Mizoram & Tripura, West Bengal & Sikkim, Orissa, Bihar plains, west Uttar Pradesh, Haryana, Punjab, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Madhya Pradesh, Vidarbha and Kerala and on 1 to 3 days over the rest of the country outside Gujarat region, Konkan & Goa, Madhya Maharashtra and coastal and north interior Karnataka, where the weather was mainly dry.

5.2. Rainfall

Rainfall during the month was excess in 5, normal in 5, deficient in 7 and scanty in 14 meteorological sub-divisions. There was no rainfall in 4 sub-divisions.

Rainfall was in excess in Nagaland, Manipur, Mizoram & Tripura, Haryana, Punjab, Himachal Pradesh and Jammu & Kashmir, normal in Arunachal Pradesh, Assam & Meghalaya, plains of west Uttar Pradesh, west Rajasthan and coastal Andhra Pradesh; deficient in West Bengal & Sikkim, east Uttar Pradesh, hills of west Uttar Pradesh, east Rajasthan, Madhya Pradesh and Telangana and was scanty in Andaman & Nicobar Islands, Orissa, Bihar, east Madhya Pradesh, Saurashtra & Kutch, Madhya Maharashtra, Marathwada, Vidarbha, Rayalaseema, Tamil Nadu, south interior Karnataka, Kerala and Lakshadweep. There was no rain in Gujarat region, Konkan & Goa, coastal and north interior Karnataka.

The significant amounts of rainfall (cm) are given below :

2nd : Parangipettai 6, Vaikom 3.

3rd : Tenkasi 6, Canning Town & Thiruvananthapuram AP 5 each, Uluberia 3.

4th : Baruiapur 10, Eraniel 4, Silchar 3.

5th : Passighat 5, Eraniel, Guwahati AP & Peddapuram 3 each.

6th : Kalpa 3.

10th : Bhuntar AP & Dalhousie 3 each.

11th : Tissa 7, Baijnath 6, Dalhousie 5, Jammu & Nawashahar 3 each.

12th : Jammu 15, Jogindernagar 9, Bhuntar AP 7, Dalhousie 5, New Delhi AP, Raya, Shimla & Sunni 3 each.

14th : Dalhousie 3.

18th : Surada 3.

19th : Surada 3.

23rd : Bhatinda 3.

24th : Chamba & Tissa 3 each.

25th : Nangal 5, Tissa 4, Baijnath, Dalhousie, Jammu & Srinagar 3 each.

26th : Dalhousie 5, Manali 4, Amha, Dharamsala, Gurgaon & Jagadhari 3 each.

27th : Nahan 6, Mandi 5, Ambala & Dalhousie 4 each, Konni, Jagadhari & Mandla 3 each.

28th : Rohru 6, Banjar 5, Rajgarh 4, Ambalavayal 3.

5.3. Temperature

During the first week of February, cold wave conditions prevailed on 1 to 3 days in hills of west Uttar Pradesh, Kashmir and Madhya Maharashtra. Cold wave conditions also prevailed on 3 to 6 days in Punjab, Himachal Pradesh and west Rajasthan and on 1 to 2 days in west Uttar Pradesh, Jammu & Kashmir and Gujarat during the period from 12th to 21st of the month. Himachal Pradesh was under the grip of cold wave conditions again during the last two days of the month. It was severe on 1 to 2 days over hills of west Uttar Pradesh, Punjab, Himachal Pradesh, west Rajasthan and Saurashtra & Kutch. Nights were generally warmer in Gangetic West Bengal, Orissa, Madhya Pradesh and east Rajasthan, where the night temperature were appreciably to markedly above normal on 12 to 18 days during the month. They were so on 7 to 10 days in Arunachal Pradesh, Nagaland, Manipur, Mizoram & Tripura, plains of west Uttar Pradesh, Haryana, Punjab, west Rajasthan, Gujarat region and Marathwada.

The lowest night temperature of the month was -5°C (dep. -3°C) recorded at Srinagar on 2nd, 3rd and 4th. In plains it was 1°C (dep. -7°C) recorded at Ganganagar (Rajasthan) on 17th.

In the plains, day temperature touched 38°C mark (dep. +6°C) at Parbhani (Marathwada region) on 4th and at Cuddapah (dep. +3°C) from 15th to 18th of this month.

5.4. *Disastrous weather events and damages*

As per media reports severe local storms and hailstorms lashed some parts of Assam, Gangetic West Bengal, Rajasthan and Telangana during the month.

On 3rd severe squall at Chakdaha and Shantipur town in Nadia district of Gangetic West Bengal claimed the life of one person and injured 20 others. On 4th evening severe squall accompanied with hail lashed in some parts of Kokrajhar district in Assam. It uprooted trees and damaged several houses. Also hailstorm occurred in some parts of Alwar and Sriganganagar

districts of Rajasthan on 11th. Delhi and neighbourhood experienced a severe thunderstorm accompanied by squall and hailstorm on 11 February 1991 associated with the passage of a western disturbance. This was the second severe hailstorm in Delhi during last five decades. The hailstorm duration was for 12 minutes from 1733 to 1745 IST and hailstones were 2 to 3 cm in diameter. It damaged crops worth rupees 3 million. In the morning of 27th severe local storms accompanied with hails swept through some parts of Lakhimpur district of Assam causing extensive damages to houses, telecommunication network and power supply in the area. On 28th about 20 villages in Karimnagar district in Telangana experienced severe hailstorms, which caused damages to crops and perished considerable number of livestock. The loss is estimated to about Rs. 100 million.