MAUSAM, **72**, 1 (January 2021), 265-280

Weather in India

WINTER SEASON (JANUARY-FEBRUARY) 2020†

1. Introduction

The winter season 2020, comprising January and February, in general had been mild in terms of temperature realized over major parts of India, except for a brief spell of *severe cold wave* / *cold wave* and *cold day** occurrences.

A persistent change in the wind pattern replaced maritime air over the southern Peninsular India by dry continental air, marking end of the northeast monsoon rains over Tamil Nadu and Puducherry, Kerala, adjoining parts of Andhra Pradesh and Karnataka from 10th January, 2020.

In the month of January, the rainfall was surplus (large excess at 164% of LPA) while in February the monthly rainfall for the country was deficient at 52% of LPA, nullifying the January excess rainfall, though the seasonal rainfall was normal at 99% of LPA.

The core of Sub-Tropical Westerly Jet (STWJ) was seen between Latitude 25 °N and 34 °N all through the season, allowing the systems in westerlies to traverse along more southern latitudes.

Dense to very dense Fog was observed over parts of northern plains on many days and on a few days over central India, east and northeast India.

No intense system formed over the Indian Seas during the season.

2. Seasonal Rainfall (January-February)

Rainfall during the season over the country as a whole was normal at 99% of LPA. Central India received *large excess* precipitation (187% of LPA), while east and northeast India (94% of LPA) and northwest India (87% of LPA) was normal. South peninsula, the rainfall was deficient with 63% of LPA. The rainfall over central India was *large excess* for both the months as well as the season.

The season witnessed 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 eastern sub-divisions of central India, adjoining peninsular India and northern plains of India, apart from dense fog and cold wave conditions over the northern plains.

(* *Definitions of terms in italics (other than subtitles) are given in Appendix.)*

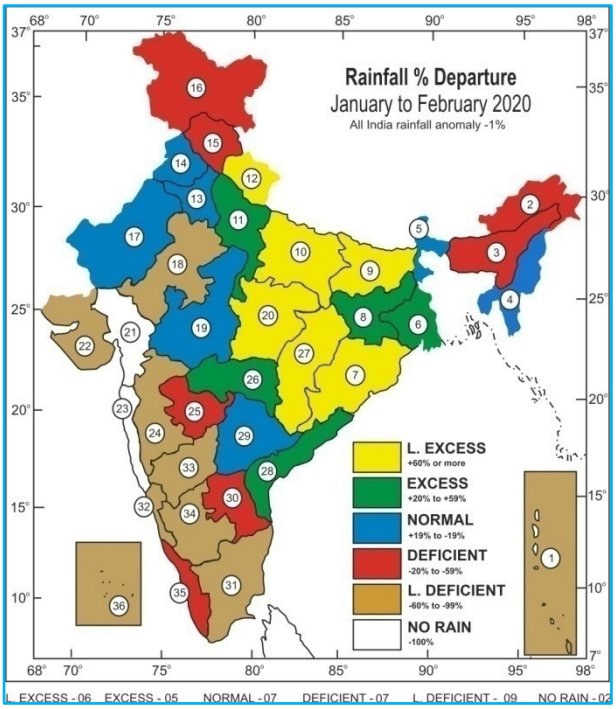

Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for post monsoon season (October to December, 2020). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	-92	**7**	116	**13**	-4	**19**	8	**25**	-56	**31**	-65
2	-33	**8**	46	**14**	9	**20**	60	**26**	43	**32**	-77
3	-25	**9**	81	**15**	-29	**21**	-100	**27**	224	**33**	-86
4	17	**10**	61	**16**	-27	**22**	-77	**28**	39	**34**	-93
5	6	**11**	51	**17**	-7	**23**	-100	**29**	-4	**35**	-57
6	20	**12**	68	**18**	-71	**24**	-99	**30**	-47	**36**	-68

The monthly and seasonal sub-divisional rainfall (actual, normal and percentage departure) are given in Table 1. Also, representative amount of rainfall on a day-to-day basis are given in Table 4. Out of the 36 meteorological sub-divisions of India, the seasonal rainfall was *large excess* in 6, *excess* in 5, *normal* in 7, *deficient* in 7, *large deficient* in 9 and *no rain* in 2 sub-divisions. The percentage departures falling under various categories, *viz*., *large excess*, *excess, normal, deficient, large deficient* and *no rain* are shown in Fig. 1.

†*Compiled by* : A. Kashyapi, P. R. Abhang, V. K. Shripad, J. G. Sonar and P. N. Chopade, Weather Monitoring Unit, Pune – 411 005, India

TABLE 1

Sub-division wise rainfall (mm) for each month and season as a whole (January - February 2020)

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	3.7	51.6	-93	2.3	23.8	-90	6.0	75.4	-92
2.	Arunachal Pradesh	61.8	47.2	31	36.3	99.5	-63	98.2	146.7	-33
3.	Assam & Meghalaya	17.5	15.5	13	17.5	31.2	-44	35.0	46.7	-25
4.	Naga., Mani., Mizo. and Tri.	33.8	12.1	180	10.2	25.7	-60	44.1	37.8	17
5.	Sub-Himalayan West Bengal & Sikkim	21.2	16.0	33	27.7	29.9	-8	48.9	45.9	6
6.	Gangetic West Bengal	34.5	12.4	178	4.9	20.4	-76	39.4	32.8	20
7.	Orissa	16.3	12.1	34	46.8	17.1	174	63.1	29.2	116
8.	Jharkhand	26.7	12.2	119	14.6	16.0	-9	41.3	28.2	46
9.	Bihar	10.8	10.0	8	25.6	10.1	153	36.3	20.1	81
10.	East Uttar Pradesh	27.6	12.2	126	13.6	13.3	2	41.0	25.5	61
11.	West Uttar Pradesh	34.7	12.3	182	9.7	17.0	-43	44.4	29.3	51
12.	Uttarakhand	131.9	41.6	217	38.9	59.8	-35	170.8	101.4	68
13.	Haryana, Chandigarh & Delhi	23.1	14.3	61	6.7	16.6	-60	29.8	30.9	-4
14.	Punjab	45.7	21.0	118	7.3	27.7	-74	53.0	48.7	9
15.	Himachal Pradesh	124.5	89.9	39	12.6	102.8	-88	137.1	192.7	-29
16.	Jammu & Kashmir and Ladakh	143.3	93.1	54	21.0	130.9	-84	164.3	224.0	-27
17.	West Rajasthan	8.1	2.9	181	0.0	5.9	-99	8.2	8.8	-7
18.	East Rajasthan	2.8	4.4	-37	0.1	5.6	-98	2.9	10.0	-71
19.	West Madhya Pradesh	11.7	6.6	77	1.8	5.9	-69	13.5	12.5	8
20.	East Madhya Pradesh	33.7	16.0	111	19.0	16.9	12	52.7	32.9	60
21.	Gujarat Region	0.0	1.0	-100	0.0	0.5	-100	0.0	1.5	-100
22.	Saurashtra & Kutch & Diu	0.2	0.4	-41	0.0	0.6	-100	0.2	1.0	-77
23.	Konkan & Goa	0.0	0.5	-100	0.0	0.2	-100	0.0	0.7	-100
24.	Madhya Maharashtra	0.0	1.6	-99	0.0	1.3	-100	0.0	2.9	-99
25.	Marathawada	2.4	4.4	-46	0.7	2.5	-73	3.0	6.9	-56
26.	Vidarbha	19.8	10.1	96	5.7	7.7	-27	25.5	17.8	43
27.	Chhattisgarh	29.6	11.1	167	39.4	10.2	286	69.0	21.3	224
28.	Coastal Andhra Pradesh & Yanam	18.6	9.7	91	12.5	12.7	-2	31.1	22.4	39
29.	Telangana	6.2	7.8	-20	7.7	6.7	15	13.9	14.5	-4
30.	Rayalaseema	4.3	3.6	19	0.0	4.5	-99	4.3	8.1	-47
31.	Tamil Nadu, Pudcherry & Karaikal	9.0	15.5	-42	1.0	12.6	-92	9.9	28.1	-65
32.	Coastal Karnataka	0.0	1.7	-100	0.6	0.8	-29	0.6	2.5	-77
33.	North Interior Karnataka	0.4	3.0	-87	0.4	2.2	-84	0.7	5.2	-86
34.	South Interior Karnataka	0.1	2.2	-95	0.3	3.6	-92	0.4	5.8	-93
35.	Kerala & Mahe	5.9	8.4	-30	3.6	14.0	-74	9.6	22.4	-57
36.	Lakshadweep	7.9	15.4	-48	0.1	9.8	-99	8.1	25.2	-68

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

3. Monthly features

3.1. *January*

3.1.1. *Storms and Depressions*

No intense system formed over the Indian Seas during the month.

3.1.2. *Weather and associated synoptic features*

As given in Table 2, 15 western disturbances (including 8 upper air cyclonic circulations, 4 troughs in westerlies and 3 induced cyclonic circulations), 21 upper air cyclonic circulations, 1 trough in easterlies and 8 other troughs formed which affected the weather over the country during the month of January.

3.1.3. *Monthly rainfall*

In this month, the rainfall over all the regions and the country were *large excess* except for the south peninsula which was *deficient* at -21%. Passage of intense western disturbances and their induced systems, high moisture feed from the Arabian Sea caused fairly widespread to widespread rainfall / snowfall activity over Western Himalayan Region along with isolated intense rainfall / snowfall activity over Jammu - Kashmir and Ladakh, Himachal Pradesh, rainfall / thunderstorm activity over the adjoining plains of northwest India; at isolated places over central India and scattered to fairly widespread rainfall / thunderstorm activity over Northeast. This triggered the monthly precipitation over central India (184% of its LPA), northwest India (172% of its LPA), east and northeast India (160% of LPA) to be large excess with the rainfall for the country being 164% of LPA. The easterly wave activity over the Indian region also remained subdued other than 3rd to 5th January resulting in the peninsula rainfall being deficient.

Out of the 36 met-sub-divisions of India, the month's rainfall was *large excess* in 14, *excess* in 5, *normal* in 3, *deficient* in 7, *large deficient* in 4 sub-divisions and *no rain* in 3 sub-divisions (Gujarat, Konkan & Goa and Coastal Karnataka).

3.1.4. *Temperature*

Maximum temperature was below normal over most parts of the country except south peninsular India. Some stations of south peninsular India even recorded the highest maximum temperature so far, for the month.

A list of stations is given with their previous record and date.

Station Name	Previous Record (°C)	Date	New Record (°C)	Date Jan 2020
Anantpur	36	25/1/2002	37.1	31
Madurai AP	34.3	9/1/1981	35.0	30
Bengaluru	32.8	24/1/2000	33.5	30
Mysuru	32.8	27/1/1936	33.9	30
Alapuzha	36.7	29/1/1998	37.3	24

Source : IMD Climate Diagnostics Bulletin of India January 2020

Severe cold wave conditions prevailed at isolated places over Haryana, Rajasthan on 10th, over Madhya Pradesh on 11th and over Odisha on 12th.

Cold wave to severe cold wave conditions observed at isolated places over Haryana, West Bengal, Sikkim, Punjab, west Rajasthan, Vidarbha, Himachal Pradesh, Jammu - Kashmir and Ladakh on one or two days in the first fortnight of the month.

Cold wave conditions were observed for 2 to 4 days over northwest and central India at isolated places over Punjab, Madhya Pradesh, Odisha, east Rajasthan, Chhattisgarh, Bihar and Jharkhand.

The minimum temperatures were *normal to above normal* over most parts of the country except for some parts of northern and central India and the season's lowest minimum temperature over the plains of the country was 1.1 °C at Hissar (Haryana) on 10th January.

3.1.5. *Damages associated with Disastrous weather events*

As per media reports, *rabi* crops as well as fruits and vegetable crops were damaged due to hailstorm in Akola, Amravati, Hingoli, Nagpur, Nanded, Wardha, Washim and Yavatmal districts of Maharashtra on 1st, 2nd and 8th January. Frequent western disturbances led to relentless snowfall in the high-altitude regions across the western Himalayan region, which triggered avalanches at multiple places claiming as many as 10 lives, 4 soldiers, 1 BSF constable and 5 civilians in Jammu - Kashmir and Ladakh on 14th January. Due to *severe cold wave*, claimed about 46 lives in northern India. At least 20 passengers were injured on the morning of 16th January after the Bhubaneswar-Mumbai Lokmanya Tilak Express collided with a goods train near Nergundi railway station, close to Salagaon in Odisha, resulting in the derailment of eight coaches. The accident is said to have occurred due to poor visibility amid dense fog in the area. *Dense fog* has also hampered life in other parts of the country. Most parts of Punjab, Haryana, Chandigarh also remained under dense fog cover in the morning, effectively throwing normal life in the region out of gear.

TABLE 2

Details of the weather systems during January 2020

S. No.	System	Duration	Place of initial Location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Western disturbances /Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	Between 3.1 & 3.6 kms a.s.l.	6-8	Afghanistan and neighborhood	East	North Pakistan and neighbourhood	Initially it lay as a trough in mid & upper tropospheric westerlies at 5.8 kms above m.s.l. ran roughly along Long. 50° E to the north of Lat. 30° N on 5. It became less marked on 9
2.	At 1.5 kms a.s.l.	6-7	Sub Himalayan west Bengal and neighbourhood	Do	South Assam and neighbourhood	Initially it lay as a trough in westerlies between 1.5 & 2.1 kms above m.s.l. ran roughly along Long. 90° E to the north of Lat. 23° N on 5. Became less marked on 8
3.	At 3.1 km a.s.l.	10-13	Iran and neighbourhood	Do	Afghanistan and adjoining Pakistan	With a trough aloft in mid & upper tropospheric level with its axis at 5.8 kms above m.s.l. ran roughly along Long. 50° E to the north of Lat. 27° N on 11. It became less marked on 14. However, trough moved away northeastwards
4.	Upto 7.6 km a.s.l.	15-19	Afghanistan & neighbourhood	Do	Eastern parts of Jammu & Kashmir	With a trough aloft in mid & upper tropospheric level with its axis at 7.6 kms above m.s.l. ran roughly along Long. 71° E to the north of Lat. 23° N on 16 and moved away east northeastwards on 18. However, WD as a cyclonic circulation moved away northeastwards
5.	Between 2.1 & 3.1 kms a.s.l	20-23	Do	Do	Jammu & Kashmir and neighbourhood	Moved away east northeastwards
6.	At 3.1 km a.s.l.	24-27	Do	Do	North Pakistan and adjoining Jammu & Kashmir	With a trough aloft in mid & upper tropospheric level with its axis at 5.8 kms above m.s.l. ran roughly along Long. 60° E to the north of Lat. 30° N and became less marked on 25. However, WD as a cyclonic circulation moved away northeastwards
7.	Between 3.1 & 7.6 kms a.s.l.	28-30	North Pakistan & neighborhood	Northeast	Jammu & Kashmir and neighbourhood	Initially it lay as a trough in mid & upper tropospheric levels with its axis at 5.8 kms above m.s.l. ran roughly along Long. 62° E to the north of Lat. 30° N on 26 & became less marked on 30. However, WD as a cyclonic circulation. Moved away northeastwards
8.	Between 3.1 & 3.6 a.s.l.	31 Jan - 1 Feb	Afghanistan & neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	Initially it lay as a trough in mid & upper tropospheric westerlies with its axis at 5.8 kms above m.s.l. ran roughly along Long. 55° E to the north of Lat. 30° N on 30 & became less marked on 1February. However, WD as a cyclonic circulation moved away northeastwards on 2 February

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(*ii*)	*As a trough*					
1.	Mid & upper tropospheric westerlies with its axis at 5.8 kms a.s.l.	2-4	Roughly along Long. 60° E to the north of Lat. 35° N	East	Along Long. 71° E to the north of Lat. 35° N	Moved away east northeastwards
2.	Upper tropospheric westerlies with its axis at 9.5 kms a.s.l.	3-4	Roughly along Long. 84° E to the north of Lat. 25° N	Do	Long. 88° E to the north of Lat. 25° N	Moved away east northeastwards
3.	Mid & upper tropospheric westerlies with its axis at 5.8 kms a.s.l.	9	Roughly along Long. 78° E to the north of Lat. 28° N	Stationary	*In situ*	Moved away northeastwards
4.	Do	17-19	Roughly along Long. 65° E to the north of Lat. 32° N	East	Long. 82° E to the north of Lat. 28° N	Moved away east northeastwards
(*iii*)	*As an induced cyclonic circulation*					
1.	At 0.9 km a.s.l.	7-8	Southwest Rajasthan & neighbourhood	Northeast	Northwest Rajasthan and neighbourhood	Became less marked on 9
2.	Upto 0.9 km a.s.l.	12-14	South Pakistan & neighbourhood	Do	Do	Became less marked on 15
3.	Upto 1.5 kms a.s.l.	27-29	Southwest Rajasthan & neighbourhood	Stationary	Northern parts of Haryana & neighbourhood	Became less marked on 30
(**B**)	*Other upper air cyclonic circulations*					
1.	Upto 0.9 km a.s.l.	1	Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 2
2.	Between 3.1 & 3.6 kms a.s.l.	3	Northwest Uttar Pradesh and neighborhood	Do	Do	Became less marked on 4
3.	At 3.1 km a.s.l.	3-4	Gangetic west Bengal & neighbourhood	Northeast	Sub Himalayan west Bengal, Sikkim & adjoining Bangladesh	Became less marked on 5
4.	Upto 0.9 kms a.s.l.	3-5	Maldives and neighbourhood	West	Eastcentral Arabian Sea off Karnataka coast	Became less marked on 6
5.	At 1.5 km a.s.l.	4	Southwest Madhya Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 5
6.	At 0.9 km a.s.l.	4	South Madhya Maharashtra and neighbourhood	Do	Do	Became less marked on 5
7.	At 1.5 km a.s.l.	7-10	North Haryana and neighbourhood	Do	Bihar and neighbourhood	Became less marked on 11
8.	Upto 1.5 km a.s.l.	9	Eastern parts of Bangladesh and neighbourhood	Do	*In situ*	Became less marked on 10
9.	Upto 1.5 km a.s.l.	14-19	Southwest Bay of Bengal off Sri Lanka coast	North	Maldives area & neighbourhood	Became less marked on 20

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
10.	Upto 0.9 km a.s.l.	14-17	North Madhya Maharashtra and neighbourhood	Northeast	East Madhya Pradesh and neighbourhood	Became less marked on 18
11.	At 0.9 km a.s.l.	14	East Uttar Pradesh and adjoining Bihar	Stationary	*In situ*	Became less marked on 15
12.	Between 1.5 & 3.6 kms a.s.l.	17-18	West Uttar Pradesh & neighborhood	East	Central parts of Uttar Pradesh	It became less marked on 19
13.	Between 1.5 & 3.1 kms a.s.l.	18	East Assam & neighborhood	Stationary	*In situ*	With a trough aloft ran roughly along Long. 93° E to the north of Lat. 24° N. It became less marked on 19
14.	Between 2.1 & 3.6 km a.s.l.	19	Northwest Uttar Pradesh and neighbourhood	Do	Do	It became less marked on 20
15.	At 0.9 km a.s.l.	21	Haryana and neighbourhood	Do	Do	Became less marked on 22
16.	Upto 1.5 kms a.s.l.	21	West Rajasthan and neighbourhood	Do	Do	Became less marked on 22
17.	At 0.9 km a.s.l.	21	Madhya Maharashtra	Do	Do	Became less marked on 22
18.	At 1.5 km a.s.l.	22	West Madhya Pradesh and adjoining southeast Rajasthan	Do	Do	Became less marked on 23
19.	Upto 1.5 km a.s.l.	22-23	Southeast Assam and neighbourhood	Do	Do	Became less marked on 24
20.	At 0.9 km a.s.l.	25	East Uttar Pradesh and adjoining Bihar	Do	Do	Became less marked on 26
21.	Upto 3.1 km a.s.l.	26	Bangladesh and neighbourhood	Do	Do	Became less marked on 27
(**C**)	*Troughs in easterlies*					
1.	At 0.9 km a.s.l.	3-4	From north Interior Tamil Nadu to northeast Madhya Pradesh across interior Karnataka, Marathwada & east Vidarbha	Stationary	From Interior Tamil Nadu to the cyclonic circulation over south Madhya Maharashtra & neighbourhood	It then lay as a cyclonic circulation over south Tamil Nadu on 5 & became less marked on 6
(**D**)	*Other troughs*					
1.	Upto 1.5 km a.s.l.	1	From northwest Madhya Pradesh to cyclonic circulation over south Gujarat region and neighbourhood	Stationary	*In situ*	Became less marked on 2
2.	Between 2.1 & 3.6 kms above m.s.l.	1	A north-south trough ran from Bihar to northwest Bay of Bengal	Do	Do	Became less marked on 2
3.	Between 2.1 & 3.1 km above m.s.l.	2-3	Southwest Rajasthan to Jharkhand across north Madhya Pradesh & north Chattisgarh	West	Southwest Uttar Pradesh to north interior Odisha across northeast Madhya Pradesh & north Chattisgarh	Became less marked on 4
4.	At 0.9 km a.s.l.	9	From the cyclonic circulation over central parts of south Uttar Pradesh and neighbourhood to Vidarbha across east Madhya Pradesh	Stationary	*In situ*	Became less marked on 10

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	Upto 0.9 km a.s.l.	17	From the cyclonic circulation over east Madhya Pradesh & neighbourhood to north Chhattisgarh	Stationary	*In situ*	Became less marked on 18
6.	At 1.5 km a.s.l.	17-18	From the cyclonic circulation over west Uttar Pradesh & neighbourhood to south Gujarat region across west Madhya Pradesh	Do	Do	Became less marked on 19
7.	At 0.9 km a.s.l.	28-29	From the cyclonic circulation over northeast Rajasthan & neighbourhood to Jharkhand across south Uttar Pradesh	East	From the cyclonic circulation over northern parts of Haryana & neighbourhood to Bangladesh across south Uttar Pradesh, Bihar & central parts of Gangetic West Bengal	Became less marked on 30
8.	Upto 0.9 km a.s.l.	30	A north-south trough ran from Sub Himalayan west Bengal to coastal Andhra Pradesh across interior Odisha	Stationary	*In situ*	Became less marked on 31

3.2. *February*

3.2.1. *Storms and Depressions*

No intense system formed over the Indian Seas during the month.

3.2.2. *Other synoptic features and associated weather*

As given in Table 3, 14 western disturbances (including 7 upper air cyclonic circulations, 5 troughs in westerlies and 2 induced systems), 27 upper air cyclonic circulations and 4 troughs in the easterlies and 7 other troughs/wind discontinuities formed which affected the weather over the country during the month of February.

3.2.3. *Monthly rainfall*

Rainfall over the country during the month was *large deficient* for northwest India, *deficient* for east and northeast India, south peninsula, the country as a whole and large excess for central India. An anomalous trough in the lower levels was observed from northeast India to central India, causing wind confluence of westerlies and moist easterlies from the Bay of Bengal leading to fairly widespread to widespread rainfall / thunderstorm activity over parts of central and eastern India.

In the first three weeks of the month the rainfall over the country as a whole was very subdued except for central India. Wind confluence between westerlies and moist easterlies from the Bay of Bengal caused scattered to fairly widespread rainfall / thunderstorm activity over east and adjoining parts of central India with heavy rainfall activity at isolated places over these regions. Thereafter an intense western disturbance and its induced cyclonic circulation caused fairly widespread to widespread rainfall / snowfall activity along with heavy falls at isolated places over Western Himalayan Region and caused scattered to fairly widespread rainfall / thunderstorm activity along the adjoining plains of northwest India. Hailstorm activity at isolated places was reported from these regions in association with the passage of the Western Disturbances.

During the month, out of 36 meteorological sub-divisions, 3 sub-divisions received *large excess* rainfall (2 from Central India and 1 from East India), 6 *normal*, 5 *deficient* and 18 *large deficient* rainfall (7 from South Peninsula, 6 from Northwest India, 3 from northeast India and 2 from central India), no sub-division received *excess rainfall.* Four sub-divisions (Gujarat region Saurashtra & Kutch, Madhya Maharashtra and Konkan & Goa) did not receive any rain. Table 1 shows the sub-division wise rainfall statistics (mm) for February 2020.

TABLE 3

Details of the weather systems during February 2020

S. No.	System	Duration	Place of initial Location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Western disturbances / Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	At 3.1 km a.s.l.	3-5	Afghanistan & neighbourhood	East	Jammu & Kashmir and neighbourhood	Initially it lay as a trough in mid & upper tropospheric westerlies with its axis at 5.8 km a.s.l. and along Long. 51° E and to the north of Lat. 33° N on 2 and became less marked on 5. However, WD as a cyclonic circulation moved away northeastwards
2.	Between 3.1 & 5.8 km a.s.l.	6 (Eve) - 7	North Pakistan and adjoining Jammu & Kashmir	Do	Himachal Pradesh and neighbourhood	Initially it lay as a trough in mid & upper tropospheric westerlies with its axis at 5.8 km a.s.l. and along Long. 60° E and to the north of Lat. 30° N on 5. It moved away northeastwards
3.	Between 3.1 & 3.6 km a.s.l.	10-12	Afghanistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	It moved away northeastwards
4.	At 3.1 km a.s.l.	14-15	North Pakistan and adjoining Jammu & Kashmir	Do	Eastern parts of Jammu & Kashmir	Initially it lay as a cyclonic circulation over west Iran & neighbourhood on 11.It then lay as a trough in mid & upper tropospheric westerlies with its axis at 5.8 km a.s.l. and along Long. 53° E and to the north of Lat. 30° N on 12. The remnant of WD as a trough ran roughly along Long. 73° E and north of Lat. 35° N on 14 &moved away northeastwards on 15. However, WD as a cyclonic circulation moved away northeastwards
5.	Between 3.1 & 4.5 km a.s.l.	17-18	Afghanistan and adjoining Pakistan	Do	Kashmir and neighbourhood	It moved away east northeastwards on 19
6.	At 5.8 km a.s.l.	28 Feb - 2 Mar (Mor)	Northwest Afghanistan andneighbourhood	Do	Eastern parts of Jammu & Kashmir	It initially lay as a trough in mid tropospheric westerlies with axis at 5.8 km a.s.l. ran roughly along Long. 55° E and to the north of Lat. 28° N on 27. Trough aloft at 7.6 km a.s.l. ran roughly along Long. 64° E and to the north of Lat. 28° N. Subsequently it moved away northeastwards
7.	Do	25-26	Afghanistan and neighbourhood	Do	East Afghanistan and neighbourhood	WD as a cyclonic circulation became less marked on 27. Trough aloft in mid tropospheric westerlies with axis at 5.8 km a.s.l. during 26-28 and moved away east northeastwards
(*ii*)	*As a trough in westerlies*					
1.	At 3.1 km a.s.l.	8	Along Long. 82° E to the north of Lat. 28° N	Stationary	*In situ*	Merged with the cyclonic circulation over Sub Himalayan West Bengal & Sikkim and neighbourhoodon 9
2.	At 5.8 km a.s.l.	15-16	Along Long. 58° E to the north of Lat. 33° N	East	Along Long. 70° E to the north of Lat. 33° N	Moved away northeastwards

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	At 3.1 km a.s.l.	16	Along Long. 90° E to the north of Lat. 22° N	Stationary	*In situ*	Then it lay as a cyclonic circulation over Sub Himalayan west Bengal & neighbourhood between 1.5 & 3.1 km a.s.l. on 17 & became less marked on 18
4.	Between 3.1 & 5.8 km a.s.l.	18	Along Long. 91° E to the north of Lat. 25° N	Do	Do	Became less marked on 19
5.	Between 3.6 & 5.8 km a.s.l.	26-28	Along Long. 86° E to the north of Lat. 25° N	East	Along Long. 93° E to the north of Lat. 25° N	Became less marked on 29
(*iii*)	*As an induced cyclonic circulation*					
1.	Upto 1.5 km a.s.l.	19-21	Central Pakistan & neighbourhood	East	South Haryana and neighbourhood	Initially, it lay as a cyclonic circulation over north Pakistan & neigbourhood between 3.1 & 3.6 km a.s.l. with a trough aloft with its axis at 5.8 km a.s.l. ran roughly along Long. 67° E to the north of Lat. 28° N on 19. Again, it lay as a cyclonic circulation over central parts of south Uttar Pradesh & neighbourhood at 1.5 km a.s.l. on 22 & became less marked over north Bihar & adjoining Sub Himalayan West Bengal on 27
2.	Do	28 Feb - 3 Mar	Central Pakistan and adjoining northwest Rajasthan	Do	Southwest Rajasthan and neighbourhood	It formed under the influence of WD over northwest Afghanistan & neighbourhood. Became less marked on 3
(**B**)	*Other upper air cyclonic circulations*					
1.	At 0.9 km a.s.l.	1-2	South Maharashtra and adjoining north interior Karnataka	West	South Konkan and Goa coast	Became less marked on 3
2.	At 1.5 kms a.s.l.	1	Central parts of Bangladesh	Stationary	*In situ*	Became less marked on 2
3.	At 3.1 kms a.s.l.	3	North coastal Tamil Nadu and neighbourhood	Do	Do	Became less marked on 4
4.	Upto 1.5 kms a.s.l.	4	Southwest Madhya Pradesh and neighbourhood	Do	Do	Became less marked on 5
5.	Between 2.1 & 3.1 kms a.s.l.	5	Lakshadweep and neighbourhood	Do	Do	Became less marked on 6
6.	At 0.9 km a.s.l.	6-8	Madhya Maharashtra and neighbourhood	East	Marathwada and neighbourhood	Became less marked on 9
7.	Do	6-7	South Tamil Nadu and neighbourhood	West	South Kerala and neighbourhood	Became less marked on 8
8.	Upto 0.9 km a.s.l.	6	North coastal Andhra Pradesh and adjoining interior Odisha	Stationary	*In situ*	Became less marked on 7
9.	At 1.5 km a.s.l.	7-12	Bihar and neighbourhood	South	East Assam and neighbourhood	With a trough aloft at 5.8 kms a.s.l. ran roughly along Long. 85° E to the north of Lat. 25° N on 9 and became less marked on 10. However, cyclonic circulation became less marked on 13
10.	Between 1.5 & 2.1 km a.s.l.	8-10	South Konkan and neighbourhood	Do	Karnataka coast and neighbourhood	Became less marked on 11
11.	At 1.5 km a.s.l.	9	South interior Odisha and neighbourhood	Stationary	*In situ*	Became less marked on 10

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
12.	Between 3.1 & 3.6 km a.s.l.	10-12	Maharashtra coast and neighbourhood	South	Karnataka coast and neighbourhood	Became less marked on 13
13.	Upto 1.5 km a.s.l.	12	Southwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 13
14.	Between 1.5 & 2.1 km a.s.l.	14-16	Northern parts of Bangladesh and neighbourhood	Do	Do	It merged with the cyclonic circulation over Sub Himalayan West Bengal &neighbourhood on 17
15.	Upto 0.9 km a.s.l.	15-16	South Kerala coast and neighbourhood	South	Maldives and neighbourhood	Became less marked on 17
16.	At 1.5 km a.s.l.	19-20	Northeast Assam and neighbourhood	Stationary	*In situ*	It became less marked on 21
17.	Upto 0.9 km a.s.l.	19	North Odisha and neighbourhood	Do	Do	It became less marked on 20
18.	At 1.5 km a.s.l.	20	Sub Himalayan West Bengal and neighbourhood	Do	Do	It became less marked on 21
19.	At 2.1 km a.s.l.	21-22	Bangladesh and neighbourhood	Do	Do	Became less marked on 23
20.	At 0.9 km a.s.l.	21	Coastal Karnataka and neighbourhood	Do	Do	Became less marked on 22
21.	At 1.5 km a.s.l.	22-24	Southern parts of east Rajasthan and neighbourhood	Do	Southwest Madhya Pradesh and neighbourhood	Became less marked on 25
22.	Between 3.1 & 3.6 km a.s.l.	22-25	Northern parts of west Uttar Pradesh and neighbourhood	Oscillatory	Northwest Uttar Pradesh and neighbourhood	Became less marked on 26
23.	At 0.9 km a.s.l.	24	South Chhattisgarh and neighbourhood	Stationary	*In situ*	Became less marked on 25
24.	Do	24	East Bangladesh and neighbourhood	Do	Do	Became less marked on 25
25.	At 1.5 km a.s.l.	26-27	South interior Karnataka and neighbourhood	North	Coastal Karnataka and neighbourhood	Became less marked on 28
26.	Upto 1.5 km a.s.l.	26-27	East Uttar Pradesh and neighbourhood	East	East Bihar and neighbourhood	Became less marked on 28
27.	At 0.9 km a.s.l.	27-28	Central Pakistan and adjoining southwest Rajasthan	Do	Haryana and neighbourhood	Became less marked on 29
28.	Do	27	Central Assam and neighbourhood	Stationary	*In situ*	Became less marked on 28
29.	Do	29 Feb	South Madhya Maharashtra and neighbourhood	Do	Do	Became less marked on 1 March
30.	At 3.1 km a.s.l.	29 Feb	East Bangladesh and neighbourhood	Do	Do	Became less marked on 1 March
(**C**)	*Trough in easterlies*					
1.	Upto 0.9 km a.s.l.	1-6	Maldives-Lakshadweep area	West	South interior Karnataka to the centre of the cyclonic circulation over Madhya Maharashtra &neighbourhood across north interior Karnataka	Became less marked on 7

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 0.9 km a.s.l.	19-20	South Tamil Nadu to north Madhya Maharashtra across interior Karnataka	Oscillatory	Interior Tamil Nadu to north interior Karnataka across south interior Karnataka	Became less marked on 21
3.	Do	26	Comorin area to south interior Karnataka across interior Karnataka	Stationary	*In situ*	Became less marked on 27
4.	Do	28	Southeast Arabian Sea off Kerala coast	Do	Do	Became less marked on 29
(**D**)	*Other Troughs/ Wind Discontinuity*					
1.	Upto 0.9 km a.s.l.	8	South Tamil Nadu to Chhattisgarh across interior Karnataka and cyclonic circulation over Marathwada & Vidarbha	Stationary	*In situ*	Became less marked on 9
2.	At 1.5 km a.s.l.	21	From induced cyclonic circulation over south Haryana and neighbourhood to northwest Madhya Pradesh	Do	Do	Moved away northeastwards on 22
3.	Between 3.1 & 3.6 km a.s.l.	21	Along Long. 94° E to the north of Lat. 25° N	Do	Do	Moved away east northeastwards on 22
4.	At 0.9 km a.s.l.	21-23	From cyclonic circulation over coastal Karnataka to Marathwada	Oscillatory	North Konkan to north Bihar	Became less marked on 24
5.	Do	25	From cyclonic circulation over South Bihar and neighbourhood to Telangana across Chhattisgarh	Stationary	*In situ*	Became less marked on 26
6.	Upto1.5 km a.s.l.	25	From cyclonic circulation over south Bihar & neighbourhood to Manipur across west Bengal, Bangladesh & Meghalaya	Do	Do	Became less marked on 26
7.	At 0.9 km a.s.l.	29 Feb	From the induced cyclonic circulation over northwest Rajasthan & neighbourhood to northeast Rajasthan	Do	Do	Became less marked on 1 March

TABLE 4

Some representative amounts of rainfall in cm for January and February 2020 (3 cm and above)

Date	Some representative amounts of rainfall in cm for October, November and December 2019 (7 cm and above)
1 Jan	Satyabama Uty ARG 4, Kolapakkam ARG, Lakhani, Waraseoni and Chennai AP 3 each
2 Jan	Sriperumbudur 8, Kelambakkam 7, Satyabama Uty ARG 6, Malanjkhand and Cholavaram 5 each, Betul, Waraseoni, Amarkantak, Anuppur - AWS and Pathalgaon 4 each, Red Hills, Chennai AP, Paraswad, Warud, Tambaram, Matijuri, Thamaraipakkam, Chembarabakkam, Mahabalipuram, Tiwsa, Chikhalda, Chennai city, Kotma and Kaveli 3 each
3 Jan	Kandukur, Mulchera, Varni and Kawardha 6 each, Rapur, Katangi and Dich Palle 5 each, Mauda, Baldevgarh, Gandhari, Kotgiri, Nagpur AP, Hyderabad and Ramanujnagar 4 each, Poudi Uparora, Hingna, Kondagaon, Ballarpur, Jamshedpur AP, Kartala, Makloor, Bhandara, Duldula, Bheemgal, Sonepur, Lalitpur, Balaghat - AWS, Pallari / Palari, Janjgir, Jukkal, Shankargarh, Boudhgarh, Waraseoni, Korba, Khaprakhol ARG, Chamorshi, Pathalgaon, Tadwai, Etapalli, Bamra ARG, Narayanpur, Sadasivanagar, Tensa, Batoli, Lakhanpur, Burdwan, Dhamdha, Chandrapur, Ghatsila, Lalgarh, Veligandla, Birmaharajpur ARG, Simga, Surajpur, Thamaraipakkam, Rajkishorenagar and Armur 3 each
4 Jan	Saiha 7, Talcher and Sabroom 6 each, Koyyalagudem, Kankadahad ARG and Aizawal 5 each, Bapatla, Bonth, Ong Pangkong Nsdma AWS, Lunglei, Darsi, Kolasib, Shipgyar, Anandpur and Ukhrukl 4 each, Lengpui, Belonia, Kaikalur, Amfu Kalimpong, Mamit, Chungthang, Sankalan, Gangtok, Mangan, Betanati ARG, Sonamura, Kalingpong, Imphal, Amarpur, Durgachak, Mangalagiri, Bishnupur, Damthang, Majitar, Narayanpur, Khairamal, Pharasgaon, Majuli, Makadi, Khanitar, Bangiriposi, Darjeeling, Ranipool, Barrackpur IAF, Kaniha ARG and Senapati 3 each
5 Jan	Thiruvananthapuram, Thiruvananthapuram AP and Lawngtlai 7 each, Sivagiri 5, Tuting, Karamchedu, Palakoderu, Varkala, Bapatla and Watrap 4 each, Rajapalayam, Bhalukpong, Nellore and Rapur 3 each
6 Jan	Kaveli 4, Udayagiri, Satyavedu, Passighat, Thottambedu and Parangipettai 3 each
7 Jan	Kothi 5, Udayagiri, Satyavedu, Jhandutta, Kotkhai, Thottambedu, Deoprayag, Banihal, Ghumarwin and Chamoli 3 each
8 Jan	Chathaagro AWS 19, Shahpur Kandi 8, Ranjit Sagar Dam Site, Phangota, Banjar and Pathankot 7 each, Madhopur, Malakpur, Kothi, Ghumarwin and Baderwah 6 each, Kandaghat, Pachhad, Nadaun, Kathua, Solan, Gohar and Seo Bagh 5 each, Naina Davi, Katra, Palampur, Thiruvananthapuram AP, Rajhani AWS, Jogindarnagar, Rajgarh, Bhuntar AP, Batote, Sujanpur Tira, Gulmarg, Arki and Rampur Bushar 4 each, Kasauli, Baijnath, Karsog, Deoprayag, Dharmasala, Khadrala, Wangtoo, Shimla, Kotkhai, Kahu, Nahan, Govindpura AWS, Samba AWS, Shimla AP, Jhandutta, Kheri, Barthin, Naraingarh, Sundernagar, Tiuni, Tibri, Hamirpur, Banihal, Joshimath, Bharari, Bijahi, Jatton Barrage, Gurudaspur, Nagrota Surian and Kukernag 3 each
9 Jan	Deoprayag 11, Haldwani 8, Bemetara, Banbasa and Sahaspurlohara 7 each, Kawardha, Munsyari, Thankhamariya, Nawagarh, Katangi, Tehri CWC and Khadrala 6 each, Bijnor, Theog, Gondia, Gondia AP, Bilaspur, Srinagar, Malanjkhand, Jatton Barrage, Kota, Keertinagar and Bijahi 5 each, Dadupur, Radaur, Baheri, Jagadhari, Bilaspur, Paonta, Tehri, Bareilly, Nahan, Pauri, Bhatwari, Berla, Rampur Bushar, Katghora, Chhuikhadan, Sarahan, Odagi and Dhamdha 4 each, Ukhimath, Kotdwar, Chhachhrauli, Uttar Kashi, Uttar Kashi Cwc, Naraingarh, Dharchula, Simdega, Banjar, Rampur, Dehra Dun, Baloda, Gairsain, Lansdown, Jakholi, Balaghat - AWS, Joshimath, Jubbal, Pithoragarh, Jollygrant, Sakoli, Kapkot, Indri, Sadhaura, Kotkhai, Wangtoo, Nagina, Phoolbagh, Hardwar, Tajewala, Bilari, Lakhani, Bilha, Shimla, Aonla, Nawabganj, Paraswad, Amgaon, Sadakarjuni, Takhatpur, Khairagarh, Rudraprayag, Pali, Karnaprayag, Dunda, Lormi, Rajgarh, Korba, Pamgarh, Moradabad, Roorkee, Ranikhet (G), Tiuni, Solan, Janjgir, Mungeli, Dharmasala, Salekasa and Gohar 3 each
10 Jan	Nil
11 Jan	Visakhapatnam 3
12 Jan	Kupwara and Bharmaur 3 each
13 Jan	Kupwara 6, Keylong 5, Gund, Pahalgam, Gulmarg and Wangtoo 3 each
14 Jan	Kheri 9, Banihal 8, Anantnag, Batote, Quazigund, Kupwara, Katra, Baderwah, Gulmarg and Raj Pura ARG 7 each, Khudwani ARG, Srinagar and Konibal 6 each, Pahalgam, Manali, Amb, Chamba AWS, Nagrota Surian, Phangota, Madhopur and Ghumarwin 5 each, Dehra Gopipur, Guler, Rajouri, Kothi, Bharmaur, Jammu City, Ranjit Sagar Dam Site, Dasuya, Jagadhari, Kangra AP, Palampur, Kukernag, Dharmasala, Gohar, Kandaghat, Gund and Shahpur Kandi 4 each, Tissa, Tajewala, Kasauli, Malakpur, Chhatrari, Radaur, Kahu, Naina Davi, Uttar Kashi, Ferozepur, Kathua, Samba AWS, Gurudaspur, Nakodar, Chathaagro AWS, Shalimar AGRO, Kapurtala, Pooh, Wangtoo, Mussoorie, Udaipur, Baldwara, Amritsar IAF, Joshimath, Tiuni, Pathankot, Tibri, Bijahi, Arki, Muktsar, Khanna, Seo Bagh, Sirhind, Hoshiarpur AWS, Berthin AGRO, Baijnath, Aghar, Ghamroor, Amritsar Rev and Sujanpur Tira 3 each

TABLE 4 (*Contd.*)

Date	Some representative amounts of rainfall in cm for October, November and December 2019 (7 cm and above)
15 Jan	Quazigund, Pahalgam, Beberu, Harran AWS and Anantnag 3 each
16 Jan	Pahalgam, Nawabganj Tehsil, Gwalior, Kanpur AP, Kanpur city, Akbarpur Knp Dht, Gohad, Orchha, Lucknow AP, Konibal, Bhind - AWS and Safipur 4 each, Guna, Ramnagar, Datia, Bara Banki, Kanpur Teh, Srinagar, Agar, Dabra, Gulmarg, Quazigund, Pichhore and Gonda 3 each
17 Jan	Nawabganj Tehsil and Ramnagar 9 each, Tribeni / Balmikinagar and Haldwani 7 each, Gonda and Nainital 6 each, Sirauli Gauspur Tehsil and Deoprayag 5 each, Bara Banki, Banjar, Baheri, Kotdwar and Phoolbagh 4 each, Lucknow AP, Maharajganj, Moradabad, Mukteswar, Kaiserganj, Pithoragarh, Purwa, Ram Sanehi Ghat Tehsil, Safipur, Kalpi Tehsil, Gaunaha, Kanpur AP, Kanpur city, Sahabad, Ramnagar, Hardoi Teh, Akbarpur Knp Dht, Budhana, Srinagar, Ranikhet (G), Kapkot and Pauri 3 each
18 Jan	Puranpur 6, Nighasan 3
19 Jan	Pandavaiyar Head, Yingkiong and Needamangalam 5 each, Coonoor 4, Tuting, Thirumanur, Vallam, Sujanpur Tira and Madukkur 3 each
20 Jan	Tuting 7, Aluva Pwd, Cherthala, Kochi AP and Ernakulam South 3 each
21 Jan	Tuting 4
22 Jan	Kothi 4, Pahalgam and Pahalgam AWS 3 each
23 Jan	Nil
24 Jan	Nil
25 Jan	Nil
26 Jan	Nil
27 Jan	Nil
28 Jan	Nil
29 Jan	Solan and Rajgarh 6 each, Ghumarwin, Dharmasala, Banjar, Palampur, Keertinagar, Khadrala, Kufri AWS, Kothi and Undhampur ARG 5 each, Kawa AWS, Deoprayag, Gairsain, Pachhad, Kashipur, Jatton Barrage, Bhaderwah ARG, Kangra AP, Baderwah and Shimla 4 each, Kasauli, Amroha, Phangota, Duldula, Chamba AWS, Govindpura AWS, Jollygrant, Katra, Jakholi, Aghar, Moga, Hardwar, Thakurdwara, Joshimath, Berthin AGRO, Srinagar, Tiring, Dharchula, Quazigund, Chaibasa, Tiuni, Ranjit Sagar Dam Site, Baijnath, Kalpa, Simdega, Kumarsain, Barthin, Kheri, Roorkee, Shahpur Kandi, Manali, Kahu, Bijahi, Banihal, Tarantaran AWS and Kulgam AWS 3 each
30 Jan	Bhadrak AWS 5, Basudevpur AWS, Nilgiri and Haldwani 4 each, Anandpur, Rajghat, Nainital, Mukteswar, Bhoranj and Ranikhet (G) 3 each
31 Jan	Mandasa 3
1 Feb	Visakhapatnam 5, Bondapalle 3
2 Feb	Dharchula 3
3 Feb	Nil
4 Feb	Polavaram 4, Amarwara, Chicholi and Srungavarapukota 3 each
5 Feb	Paraswad, Nainpur, Baloda, Khairamal and Keolari 3 each

TABLE 4 (*Contd.*)

Date	Some representative amounts of rainfall in cm for October, November and December 2019 (7 cm and above)
6 Feb	Belaguntha ARG 5, Paralakhemundi, Palakonda and Kalingapatnam 4 each, Ernakulam South and Kochi AP 3 each
7 Feb	Seethanagaram and Sorada 6 each, Khairagarh and Aska 5 each, Tikabali, Goregaon, Arang, Mana AP, Berla, Kotagarh, Mauda, Amgaon, Paralakhemundi and Dhamdha 4 each, Simga, Salekasa, Kochi AP, Kashipur, Bijepur, Banpur, Gundardehi, G Udayagiri AWS and Durg 3 each
8 Feb	Balod 7, Rairakhol 6, Binika 5, Dondilohara, Jujumura ARG, Dhamtari, Gurur, Bijepur, Mohla, Naktideul, Ambabhona, Dunguripalli and Kurupam 4 each, Gundardehi, Kurud, Atabira ARG, Bolangir, Rajnandgaon, Arang, Pallahara, Raipur, Saraipali, Gunupur, R.Udaigiri, Ullunda ARG, Mandasa, Sonepur, Barpalli ARG, Bargarh, Gaisilet ARG, Khairamal, Nawapara, Labhandih, Khaprakhol ARG, Gariabund, Mana AP, Sohela, Patnagarh and Rajkishorenagar 3 each
9 Feb	Govindaraopet, Therlam and Merakamudidam 6 each, Machareddy, Veeraghattam, Mulug, Gajapathinagaram and Sironcha 5 each, Bhopalpatnam, Seethanagaram, Hayathnagar, Naktideul, Venkatapur, Miryalaguda, Narsapur, Kusumanchi, Bheemadevarpalle and Narayanpur 4 each, Orcha, Pallahara, Kamareddy, Rairakhol, Kantamal, Mahendragarh, Medak, Srungavarapukota, Bondapalle, Tadwai, Lingampet, Jajpur, Kowdipalle, Huzurabad, Kondapak, Reamal, Bhairamgarh, Usoor and Jukkal 3 each
10 Feb	Avanigada 5, Palakurthi and Santhamaguluru 3 each
11 Feb	Avanigada 5, Repalle 3
12 Feb	Nil
13 Feb	Nil
14 Feb	Nil
15 Feb	Punalur 4
16 Feb	Nil
17 Feb	Nil
18 Feb	Yingkiong 3
19 Feb	Nil
20 Feb	Nil
21 Feb	Ghamroor 5, Lansdown, Jollygrant, Sangraha, Mussoorie and Dehra Dun 4 each, Kharkoda, Bilari, Jatton Barrage, Dataganj, Haldwani, Dubwali, Shimla, Sahaswan, Bijnor, Mashobra AGRO and Kandaghat 3 each
22 Feb	Haldwani and Nainital 7 each, Valinokkam ARG and Champawat 5 each, Bilari and Satankulam 4 each, Kashipur, Mukteswar, Baheri, Gangolihat, Dharchula, Pamban, Almora, Kapkot, Pithoragarh, Dwarhat, Munsyari, Bikapur, Bijnor and Garud 3 each
23 Feb	Sohagpur – AWS 4
24 Feb	Pendra 6, Thankhamariya, Patharia, Lakhnadon and Banka 5 each, Takhatpur, Nainpur, Bargarh, Pratappur, Odagi, Mussoorie and Anuppur – AWS 4 each, Bilha, Bilaspur, Gangtok, Simga, Dhabhara, Jollygrant, Kartala, Bemetara, Poudi Uparora and Seovrinarayan 3 each
25 Feb	Ayoadhya 9, Nighasan, Birmaharajpur ARG, Saraipali and Ullunda ARG 8 each, Kolaras, Bijepur and Birdghat 7 each, Chatia, Dunguripalli, Basana, Khairamal, Reamal, Sonepur and Boudhgarh 6 each, Jharbandh ARG, Chanderdeepghat, Pithora, Kantamal, Barpalli ARG, Gaisilet ARG, Mana AP, Binika and Arang 5 each, Raipur, Bagbahara, Bansi Cwc, Mahasamund, Phulbani, Sohela, Kakerdarighat, Basti Cwc, Rajkishorenagar, Haraiya, Kakrahi, Dhamdha, Bargarh, Daltonganj, Athmalik and Labhandih 4 each, Rajim, Bahraich, Katerniaghat, Tarva ARG, Ramanujnagar, Faizabad, Sahaspurlohara, Bolangir, Patan, Chhuikhadan, Jujumura ARG, Balrampur, Atabira ARG, Agalpur ARG, Loisingha ARG, Tilda, Deogarh, Kheri Lakhimpur, Abhanpur, Padampur, Angul and Domeriaganj 3 each

TABLE 4 (*Contd.*)

Date	Some representative amounts of rainfall in cm for October, November and December 2019 (7 cm and above)
26 Feb	Kantapada ARG 10, Deoghar 9, Bhubaneshwar AP and Kessariah 8 each, Mohanpur and Banki ARG 7 each, Domohani, Jalpaiguri and Alipingal 6 each, Parsa, Bagaha, Darjeeling, Mohana, Belaguntha ARG and Baghdogra AP 5 each, Gudari, Gopalganj, Tigiria ARG, Vaishali, Raiganj PTO, Chakia, Motihari, Kalingpong, Bolagarh ARG, Bijnor, Tikabali, Lalbegiaghat, Sahebganj, Pathargama, Tribeniganj, Sevoke, Mahedi / Mehshi, Gaunaha, Patahi, Sabour, Kursela, Balikuda ARG and Banarpal ARG 4 each, Murti, Bhavani P., Danagadi ARG, Daitari, Tribeni / Balmikinagar, Pachrukhi, Hardwar, Gajoldoba, Damthang, Raikia ARG, Chaukhutia, Katoria, Neora, Parbatta, Hindol, Jollygrant, Champasari, Nagarkata, Parjang ARG, Balipatna ARG, Jahanabad, Nh31 Bridge, Raghunathpur ARG, Galgalia, Chanpatia, Banka, R.Udaigiri, Khandapara, Hindgir, Kankadahad ARG, Baltara, Ichchapuram, Saraiya, Atabira ARG, K Nuagaon ARG, Ramnagar, Nirmali, Bahadurganj, Taibpur, Dhengbridge, Niali ARG, Barmul, Nayagarh, Chengmari / Diana, Lanjigarh, Athgarh, Bihpur, Reamal, Sambalpur, Tikarpara, Bhanjnagar, Bhagalpur, Chargharia, Ahirwalia, Kodawanpur / C.B Ii, Deomali, Sursand and Chapra 3 each
27 Feb	Kaikalur 11, Saraiya and Beky Rly.Bridge 5 each, Williamnagar 4, Sohra, Tezpur, Beki Mathungari, Sohra (Rkm), Bhalukpong and Nongstein 3 each
28 Feb	Nil
29 Feb	Alappuzha 5, Kupwara and Udhampur IAF 4 each, Adampur IAF, Katra, Kathua and Batote 3 each

3.2.4. *Temperature*

The maximum temperature was below normal over most parts of the country except some parts of northeast India and peninsular India. In the last few days at the end of the month there was a rise in temperatures over northeast India, western parts of central India and northwest India. Heat wave conditions were observed at isolated places over Konkan on 27th February.

The minimum temperatures were generally normal or above normal over south peninsular and adjoining region, below normal over northwest and central India particularly in the first fortnight of the month. In the third week, lack of precipitation saw a rise in temperature over northwest, central India and the temperatures remained above normal till the end of the month. The lowest minimum temperature over the plains of the country was 2.0 °C at Hissar (Haryana) and Sikar (east Rajasthan) on 8th February.

Severe cold wave conditions were observed on 1 day each in isolated parts of Punjab and Odisha. *Cold wave* conditions manifested from the start of the month and were observed for many days over Haryana, Punjab, Chandigarh and Delhi in the first fortnight. Over east and Central India cold wave conditions were realized on 1 to 3 days in some parts of Odisha, Madhya Pradesh, Bihar, Jharkhand and Chhattisgarh. *Cold day conditions* were observed over Madhya Pradesh on 1 or 2 days in the first week of the month.

3.2.5. *Damages associated with disastrous weather events and damage*

According to media reports, unseasonal rain and hail damaged rabi crops, *viz*., wheat, jowar and gram in Maharashtra. Harvests of oranges, water melon, vegetables and blooming of mango plants were adversely affected.

The inputs from the offices of India Meteorological Department *viz*., (1) Director General of Meteorology (Hydromet), New Delhi and (2) Additional Director General of Meteorology (Research), Pune are gratefully acknowledged. Thanks to Smt. Padma Kulkarni, S. A. for her help in bringing out this summary.

Appendix

Definitions of the terms given in '*Italics*'

(A) Rainfall

(*i*) Percentage departure from normal

Large excess - + 60% or more

Excess - +20% to +59%

Normal - –19% to +19%

Deficient - –20% to –59%

Large deficient - –60% to –99%

No Rain - –100%

(*ii*) Intensity (during the past 24 hours period ending at 0300 UTC)

Heavy rainfall - 6.5 cm to 11.5 cm

Very heavy rainfall - 11.6 cm to 20.4 cm

Extremely heavy rainfall - 20.5 cm and above

Heavy snowfall - 64.5 cm to 115.5 cm

(B) Temperatures

Cold Wave is considered when minimum temperature of a station is 10 °C or less for plains and 0 °C or less for Hilly regions

(a) *Based on Departure*

Cold wave - Negative Departure from normal is 4.5 °C to 6.4 °C

Severe Cold Wave - Negative Departure from normal is more than 6.4 °C

Based on Actual Minimum temperature (for plain stations only)

Cold wave - When minimum temperature is ≤ 04 °C

Severe Cold Wave - When minimum temperature is ≤02 °C

(b) *Cold Day*

It should be considered when minimum temperature is 10 °C or less for plains and 0 °C or less for Hilly regions

Cold wave - Maximum temperature Departure is –4.5 °C to –6.4 °C

Severe Cold Wave - Maximum temperature Departure is < –6.4 °C

Below normal - departure from normal is –1.6 °C to –3.0 °C

Normal - departure from normal is –1.5 °C to +1.5 °C

Above Normal - departure of minimum temperature from normal is +1.6 °C to 3.0 °C

(C) *Fog*

Dense Fog - When the visibility is between 50-200 m

Very Dense Fog - When the visibility is < 50 m