MAUSAM, **72**, 2 (April 2021), 507-530

Weather in India

HOT WEATHER SEASON (March-May 2020)†

1. Chief features

The first cyclonic storm of the season and the year 2020, was the Super Cyclonic Storm (SuCS) "AMPHAN" (16-21 May) and it was the first SuCS over the Bay of Bengal, after the Odisha SuCS of 1999. Besides this system one depression formed over south coastal Oman and adjoining Yemen and a low-pressure area over south Andaman Sea and adjoining southeast Bay of Bengal.

This year heat waves had been subdued, there was a brief spell of heat wave in Gujarat in April. Frequent and intense western disturbances, systems in easterlies and their confluence with the westerlies lead to surplus precipitation, which in general kept the temperatures cooler than usual till early May. It was only after the dissipation of SuCS, "AMPHAN" that the strong and dry northwesterly winds caused heat wave to severe heat wave conditions over parts of northwest India.

Precipitation remained above its Long Period Average (LPA) during all the pre-monsoon months and hence during the season as a whole, with 46% of the country receiving *large excess** rainfall during the season.

There were frequent and widespread occurrences of thunderstorms over the country throughout the season. They were more frequent over northwest India and central India than east and northeastern regions and south peninsular regions.

Southwest Monsoon advanced into South Andaman Sea, some parts of South Bay of Bengal and Nicobar Islands on 17th May, 2020, ahead of its normal date, *i.e.*, May 20. The further advance was slow and it reached Kerala on 1st June, its normal date.

2. Seasonal rainfall

The sub-division wise rainfall and its departure from *normal* for each month and season as a whole are given in Table 1. The sub-divisional rainfall departures for the season March-May 2020 are also depicted in Fig. 1.

The seasonal rainfall for the country was *large excess* at 121% of its Long period Average (LPA), with

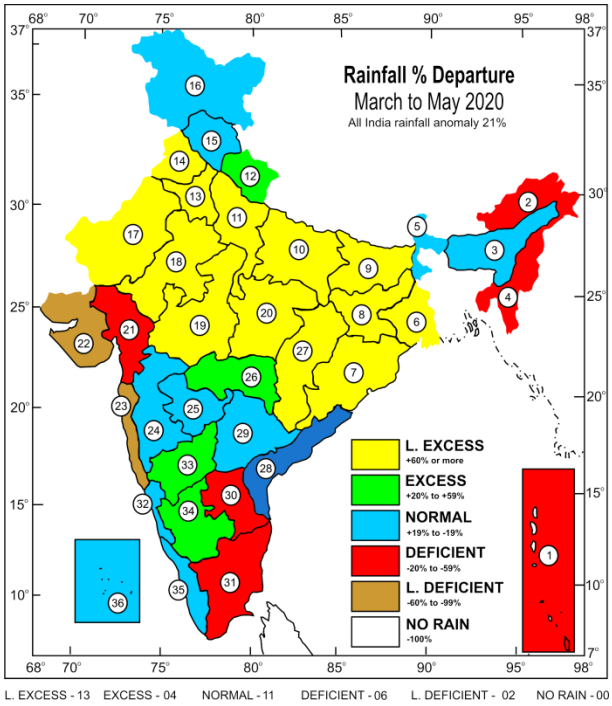

Fig. 1. Sub-divisional rainfall percentage departures (based on Operational data) for the season Mar-May, 2020. Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	-37	**7**	107	**13**	201	**19**	113	**25**	19	**31**	-39
2	-22	**8**	160	**14**	126	**20**	250	**26**	53	**32**	10
3	13	**9**	123	**15**	11	**21**	-31	**27**	192	**33**	39
4	-37	**10**	202	**16**	-1	**22**	-73	**28**	-17	**34**	26
5	13	**11**	197	**17**	126	**23**	-66	**29**	2	**35**	7
6	100	**12**	55	**18**	144	**24**	0	**30**	-20	**36**	17

March rainfall being the largest contributor at 147% of LPA. The rainfall in the months of April and May were *normal* at 109% and 116% of LPA respectively over the country. The seasonal precipitation over central India and northwest India was *large excess* at 204% and 132% of LPA respectively, while east and northeast India and south Peninsula were *normal* at 107% and 96% of LPA.

Central India recorded large excess rainfall in all the months, with March (319% of LPA) and April (265% of LPA) receiving exceptionally high surplus rainfall. Similarly, the March rainfall of northwest India with

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

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TABLE 1

Sub-division rainfall (mm) for each month and season as a whole (March-May, 2020)

S. No.	Meteorological Sub-divisions	March			April			May			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A. & N. Islands	0.1	27.9	-99%	35.9	74.2	-52%	230.1	364.7	-37%	266.1	466.8	-43%
2.	Arunachal Pradesh	49.7	182.0	-73%	183.7	303.6	-39%	361.6	287.3	26%	599.9	772.9	-22%
3.	Assam & Meghalaya	29.1	77.3	-62%	167.3	193.9	-14%	465.4	316.6	47%	663.7	587.8	13%
4.	Naga., Mani., Mizo. and Tri.	9.7	66.2	-85%	122.7	148.0	-17%	171.3	268.8	-36%	303.8	483.0	-37%
5.	Sub-Himalayan West Bengal & Sikkim	64.1	55.6	15%	155.4	125.2	24%	280.0	262.1	7%	499.5	442.9	13%
6.	Gangetic West Bengal	50.1	30.1	67%	76.5	50.1	53%	247.0	105.6	134%	371.1	185.8	100%
7.	Orissa	62.1	23.5	164%	111.3	33.9	228%	92.0	71.0	30%	265.4	128.4	107%
8.	Jharkhand	88.7	15.1	487%	56.2	19.6	187%	71.7	48.6	47%	216.5	83.3	160%
9.	Bihar	45.9	8.1	467%	55.0	16.7	229%	81.7	56.9	44%	182.6	81.7	123%
10.	East Uttar Pradesh	38.3	6.7	472%	14.8	6.0	147%	44.7	19.7	127%	97.9	32.4	202%
11.	West Uttar Pradesh	48.5	9.2	427%	13.2	5.4	144%	27.1	15.3	77%	88.8	29.9	197%
12.	Uttarakhand	117.8	54.9	115%	51.8	34.8	49%	71.8	65.6	9%	241.3	155.3	55%
13.	Haryana, Chandigarh & Delhi	69.1	12.1	471%	7.9	7.9	0%	40.9	19.3	112%	118.3	39.3	201%
14.	Punjab	80.0	23.7	237%	16.9	13.5	25%	27.9	17.9	56%	124.7	55.1	126%
15.	Himachal Pradesh	159.7	110.9	44%	53.1	65.7	-19%	58.0	66.8	-13%	270.9	243.4	11%
16.	Jammu & Kashmir	201.2	152.3	32%	66.4	103.1	-36%	63.6	79.8	-20%	330.5	335.2	-1%
17.	West Rajasthan	22.7	4.5	404%	4.9	4.9	0%	23.2	13.1	77%	50.8	22.5	126%
18.	East Rajasthan	21.8	3.5	523%	6.5	3.7	76%	18.0	11.8	53%	46.4	19.0	144%
19.	West Madhya Pradesh	14.6	4.4	232%	1.9	2.1	-9%	10.9	6.4	71%	27.4	12.9	113%
20.	East Madhya Pradesh	41.3	10.8	282%	16.7	4.8	249%	24.7	8.0	208%	82.7	23.6	250%
21.	Gujarat Region	3.5	1.0	248%	0.0	0.7	-100%	0.8	4.6	-82%	4.3	6.3	-31%
22.	Saurashtra & Kutch & Diu	0.8	1.0	-16%	0.2	0.3	-26%	0.0	2.7	-99%	1.1	4.0	-73%
23.	Konkan & Goa	0.0	1.0	-99%	7.3	2.0	263%	5.0	33.0	-85%	12.2	36.0	-66%
24.	Madhya Maharashtra	8.8	2.9	203%	7.8	7.2	8%	15.9	22.4	-29%	32.5	32.5	0%
25.	Marathawada	12.2	6.0	103%	10.3	5.5	87%	10.3	15.9	-35%	32.7	27.4	19%
26.	Vidarbha	27.8	10.4	168%	6.4	6.5	-1%	7.5	10.5	-28%	41.8	27.4	53%
27.	Chhattisgarh	50.7	10.6	378%	29.1	12.4	134%	39.9	18.0	121%	119.6	41.0	192%
28.	Coastal Andhra Pradesh	20.0	13.5	48%	43.9	22.3	97%	18.4	62.9	-71%	82.3	98.7	-17%
29.	Telangana	15.9	12.3	30%	20.9	17.6	19%	24.3	29.9	-19%	61.1	59.8	2%
30.	Rayalaseema	6.5	9.3	-30%	32.7	18.7	75%	26.2	54.1	-52%	65.4	82.1	-20%
31.	Tamil Nadu, Pudcherry & Karaikal	3.9	21.4	-82%	33.8	39.5	-14%	38.2	64.5	-41%	75.9	125.4	-39%
32.	Coastal Karnataka	7.5	7.8	-3%	42.1	26.2	61%	121.2	121.7	0%	170.8	155.7	10%
33.	North Interior Karnataka	12.0	7.4	62%	33.6	23.4	44%	65.2	49.2	33%	110.9	80.0	39%
34.	South Interior Karnataka	8.5	11.3	-24%	60.0	42.4	41%	108.2	86.7	25%	176.7	140.4	26%
35.	Kerala & Mahe	44.2	32.7	35%	110.9	105.1	5%	232.3	223.7	4%	387.3	361.5	7%
36.	Lakshadweep	13.8	10.7	29%	8.8	35.2	-75%	214.7	157.4	36%	237.3	203.3	17%

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

177% of LPA rainfall too was large excess. This extraordinarily enhanced rainfall activity over northwest and central India can be attributed to the movement of frequent and intense western disturbances and their induced systems (one western depression in the month of March). Likewise, wind confluence between westerlies and moist easterlies caused rainfall / thunderstorm activity over parts of central India.

3. Significant features during various months

3.1. *March*

3.1.1. *Weather and associated synoptic features*

The details of the weather systems during the month are summarised in Table 2 and the principal amount of rainfall are given in Table 5.

The rainfall in the month of March was *large excess* at 147% of LPA over the country along with central India at 319% of LPA and northwest India at 177% of LPA. Precipitation over South peninsula was *normal* at 89% of LPA while east and northeast region was deficient at 73% of LPA.

Delhi based monitoring station at Safdarjung recorded 109.6 mm rainfall in the month of March 2020 against monthly normal of 15.9 mm (a huge departure of +589%). In the process, March 2020 surpassed the previous record of March 2015, during which Delhi had received rainfall worth 97.4 mm.

Some of the stations of north and central India received record 24 hour rainfall. A list of stations is given below with their previous record and date.

Station name	*Previous record (mm)*	*Date of record*	*Year of record*	*New record (mm)*	*Date March 2020*
Gaya AP	37.6	13	1891	43.1	14
Varanasi AP	45.3	11	2005	46.2	14
Sultanpur	18.5	27	1993	22.8	14
Muzzafarnagar	38.4	2	1982	38.4	14
Phoolbaug	21.4	13	1998	23.5	7
Pantnagar	12.8	25	1967	23.5	7
Katra AP	116.2	23	1990	151.8	28
Kota	16.8	9	1989	18	27
Umaria	43.4	3	1941	46.2	13
Aurangabad AP	25. 4	10	2006	33.3	31
Mana AP	23.8	2	1982	45.2	13

Source : IMD Climate Diagnostics Bulletin of India March 2020

3.1.2. *Temperature distribution*

(a) *Minimum temperatures*

No *Cold day* or *Cold wave* conditions observed in this month.

The minimum temperatures over the country were generally *normal* / *above normal* on most days, except for some days in the second and third week when they were *below normal* over northwest and central India.

The months and the season's lowest minimum temperature over the plains was 7.0 °C at Ludhiana (Punjab) on 15th March, 2020.

(b) *Maximum temperatures*

Heat wave conditions were not observed in this month.

The maximum temperatures were generally *normal/below normal* over the country in this month. Consecutive passage of western disturbances and their induced systems, favorable conditions for intense convective activity generated by lower tropospheric instability and upper level velocity divergence, moisture incursion in the lower tropospheric levels led to well distributed rainfall / hailstorms over northwest, central and adjoining peninsular India.

The month's highest maximum temperature over the plains was 42.0 °C at Khargone (west Madhya Pradesh) on 31st March, 2020.

3.1.3. *Disastrous weather events and damage*

According to media and other disaster reports, lightning caused death of 11 persons in the second week of March in Sidhi, Sagar, Damoh, Shahdol, Ratlam, Dewas and Mandla districts of Madhya Pradesh. Lightning caused 6 casualties in Yeotmal district of Maharashtra. Rain / thunderstorms took lives of 3 persons in Rohtas (Bihar), 4 in various districts of Jharkhand and 957 livestock in Aurangabad (Bihar), in different incidents. Heavy rain leading to landslide caused 3 casualties in Darjeeling (West Bengal) and a shed collapsed due to thunderstorm causing death of 1 person in Shirpur Taluka of Dhule district (Maharashtra) in the second week of March. Media also reported that hailstorm caused heavy damage to *rabi* crops as well as fruits and vegetables in many districts of Maharashtra and Madhya Pradesh on 19th March. Snow avalanche took toll

TABLE 2

Details of the weather systems during March 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*)	*Western depression*					
1.	At mean sea level	12	Central Pakistan and neighbourhood along with its associated cyclonic circulation which extended up to 9.5 km above m.s.l. tilting westwards with height	East northeast	North Pakistan and neighbourhood	Initially, it lay as a trough in mid-tropospheric level with its axis at 5.8 km above m.s.l. ran roughly along Long. 62° E to the north of Lat. 30° N on 7. It lay as a cyclonic circulation over Afghanistan and neighbourhood between 3.1 and 5.8 km above m.s.l. on 8. It weakened into a cyclonic circulation over north Pakistan and neighbourhood in the morning of 13. It lay as a trough with its axis at 5.8 km above m.s.l. running roughly along Long. 80° E to the north of Lat. 25° N on 16 and Moved away northeastwards on 17
(*ii*)	*Upper air cyclonic circulation*					
1.	Between 5.8 and 7.6 km above m.s.l.	3-7	Iran and neighbourhood	East	Central Pakistan, adjoining Punjab	With a trough aloft with its axis at 7.6 km above m.s.l. running roughly along Long. 63° E to north of Lat. 25° N on 5. It moved away northeastwards
2.	Between 1.5 and 3.1 km above m.s.l.	19-21	Northeast Afghanistan and adjoining Pakistan	Do	Eastern parts of Jammu-Kashmir	Moved away northeastwards
3.	Between 3.1 and 3.6 km above m.s.l.	23-26	Northeast Afghanistan and neighbourhood	Do	Jammu-Kashmir and adjoining north Pakistan	Moved away northeastwards
4.	Up to 7.6 km above m.s.l.	24-27	Western parts of Iran and neighbourhood	Do	Roughly along Long. 64° E to the north of Lat. 28° N	It lay as a trough in mid and upper tropospheric westerlies with its axis at 5.8 km above m.s.l. running roughly along Long. 69° E to the north of Lat. 29° N on 28 and moved away northeastwards
5.	Between 1.5 and 3.1 km above m.s.l.	29 Mar - 1 Apr	West Iran and neighbourhood	Do	North Pakistan and neighbourhood	Lay as a trough in mid tropospheric westerlies with its axis at 5.8 km above m.s.l. running roughly along Long. 71° E to the north of Lat. 34° N on 2 April which moved away north-eastwards
(*iii*)	*As a trough*					
1.	At 5.8 km above m.s.l.	16	Roughly along Long. 55° E to the north of Lat. 30° N	East	East Iran and neighbourhood	It lay as a cyclonic circulation over east Iran and neighbourhood at 3.1 km above m.s.l. on 17. Became less marked on 18
2.	Do	19-20	With its axis at 5.8 km above m.s.l. running roughly along Long. 80° E to the north of Lat. 32° N	Stationary	Ran roughly along Long. 87° E to the north of Lat. 25° N	Initially it lay as a cyclonic circulation over north Pakistan & neighbourhood on 18. Became less marked on 21
3.	At 5.8 kms.a.s.l.	31 Mar - 1 Apr	Roughly along Long. 60° E to the north of Lat. 30° N	East	Along Long. 62° E to the north of Lat. 32° N	It merged with the western disturbance's trough in mid tropospheric westerlies on 2

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(*iv*) *As an Induced / Low / cyclonic circulation*						
1.	Up to 1.5 km above m.s.l.	4	South Pakistan and neighbourhood	East	East Rajasthan and adjoining northwest Madhya Pradesh	Became less marked on 5
2.	An induced low at mean sea level	5-7	Southwest Rajasthan and neighbourhood	North	West Rajasthan and adjoining Pakistan	Initially it lay as an induced cyclonic circulation over south Pakistan and neighbourhood on 4. Became less marked on 7
3.	Up to 2.1 km above m.s.l.	10-11	Do	Stationary	*In situ*	Merged with the Western Depression on 12
4.	At 0.9 km a.s.l.	13-14	Haryana & neighbourhood	East	Northeast Rajasthan and neighbourhood	It merged with the Western Disturbance's cyclonic circulation over Haryana and neighbourhood on 15
5.	Upto 0.9 km a.m.s.l.	23-25	South Pakistan and neighbourhood	Do	West Rajasthan and adjoining Pakistan	Became less marked on 26
6.	Upto 1.5 km a.s.l.	31 Mar - 1 Apr	Pakistan and adjoining west Rajasthan	Do	East Rajasthan and neighbourhood	Became less marked on 2
(**B**) *Other upper air cyclonic circulations*						
1.	Upto 0.9 kms a.s.l.	1-2	Coastal Karnataka and neighborhood	Stationary	*In situ*	Became less marked on 3
2.	Upto 1.5 kms a.s.l.	2	Gangetic West Bengal and adjoining Bangladesh	Do	Do	Became less marked on 3
3.	At 3.1 kms a.s.l.	3	Lakshadweep and neighbourhood	Do	Do	Became less marked on 4
4.	Up to 1.5 km above m.s.l.	3-4	Northwest Madhya Pradesh and neighbourhood	West	Northeast Rajasthan and neighbourhood	Became less marked on 5
5.	At 0.9 km above m.s.l.	3-4	Assam and neighbourhood	South	South Assam and Meghalaya	Became less marked on 5
6.	At 3.1 km above m.s.l.	4	North Haryana and neighbourhood on 4	Stationary	*In situ*	Became less marked on 5
7.	Between 1.5 and 4.5 km above m.s.l.	4	Northeast Assam and neighbourhood	Do	Do	Became less marked on 5
8.	Upto 1.5 kms a.s.l.	4	Gangetic West Bengal and neighbourhood	Do	Do	Became less marked on 5
9.	Do	5-7	North Bangladesh and neighbourhood	East	Central Assam and neighbourhood	Became less marked on 8
10.	Between 1.5 and 2.1 km above m.s.l.	6	Sub-Himalayan West Bengal and neighbourhood	Stationary	*In situ*	Became less marked on 7
11.	At 0.9 km a.s.l.	6-7	Southeast Arabian Sea off Kerala coast	West	Lakshadweep and neighbourhood	Became less marked on 8
12.	Upto 0.9 km a.s.l.	7	Central parts of south Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 8

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	Between 1.5 km and 3.1 km above m.s.l.	8	Haryana and neighbourhood	Stationary	*In situ*	Became less marked on 9
14.	At 0.9 kms a.s.l.	8	North interior Karnataka and neighbourhood	Do	Do	Became less marked on 9
15.	Between 1.5 and 2.1 km above m.s.l.	9	South Sri Lanka and neighbourhood	Do	Do	Became less marked on 10
16.	At 1.5 km a.s.l.	9-10	Madhya Maharashtra and neighbourhood	East	Marathwada and neighbourhood	Became less marked on 11
17.	Up to 0.9 km above m.s.l.	13-16	East Uttar Pradesh & neighbourhood	South	South Chhattisgarh & neighbourhood	Merged with the trough from north Tamil Nadu to east Vidarbha on 17
18.	Upto 0.9 km a.s.l.	13-14	South Tamil Nadu & adjoining Comorin area	West	Maldives-Lakshadweep area	Became less marked on 15
19.	At 1.5 km above m.s.l.	13	South Assam & neighbourhood	Stationary	*In situ*	Became less marked on 14
20.	At 1.5 km a.s.l.	15	East Uttar Pradesh and neighbourhood at 1.5 km	Do	Do	Became less marked on 16
21.	Between 0.9 & 1.5 km above m.s.l.	15	East Bangladesh & neighbourhood	Do	Do	Became less marked on 16
22.	Upto 0.9 km a.s.l.	17	North coastal Odisha and neighbourhood	Do	Do	Became less marked on 18
23.	Do	18-20	Madhya Maharashtra & neighbourhood	East	West Vidarbha and neighbourhood	Became less marked on 21
24.	At 0.9 km above m.s.l.	18	East Assam & neighbourhood	Stationary	*In situ*	Became less marked on 19
25.	At 0.9 km a.s.l.	19-23	Southwest Rajasthan and neighbourhood	Southeast	Central parts of Rajasthan	Became less marked on 24
26.	At 1.5 kms a.s.l.	19-20	Comorin area and neighbourhood	Stationary	*In situ*	Became less marked on 21
27.	Upto 0.9 km a.s.l.	20-21	North Haryana and neighbourhood	Do	Northeast Haryana and neighbourhood	Became less marked on 22
28.	Do	20-22	Central Assam and neighbourhood	East	East Assam and neighbourhood	Became less marked on 23
29.	At 0.9 km above m.s.l.	22	North interior Karnataka and neighbourhood	South	North interior Karnataka, adjoining south Madhya Maharashtra	Became less marked on 25
30.	Upto 0.9 km a.s.l.	23-25	South Assam, Meghalaya and neighbourhood	West	Manipur-Mizoram and neighbourhood	Became less marked on 26
31.	Do	25	North Odisha and neighbourhood	Stationary	*In situ*	Became less marked on 26
32.	Upto 1.5 km a.s.l.	31 Mar to 1 Apr	South coastal Tamil Nadu and neighbourhood	Do	Do	Became less marked on 1 April
33.	At 0.9 km above m.s.l.	31 Mar - 1 Apr	Lay over West Bengal and adjoining Bangladesh	East	Northeast Bangladesh and neighbourhood	It became less marked on 2 April

TABLE 2 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**C**) *East west trough*						
1.	At 1.5 km a.s.l.	7	East Uttar Pradesh to Bangladesh across Bihar and West Bengal	Stationary	*In situ*	Became less marked on 8
2.	Do	8	From coastal Karnataka to north Tamil Nadu	Do	Do	Became less marked on 9
3.	At 0.9 km above m.s.l.	11-12	From the induced cyclonic circulation over southwest Rajasthan and neighbourhood to north Chhattisgarh	West	From the cyclonic circulation over central Pakistan & neighbourhood to north Chhattisgarh	Became less marked on 13
4.	Do	13-14	From the cyclonic circulation over east Uttar Pradesh and neighbourhood to west Vidarbha	Do	From the cyclonic circulation over north Chhattisgarh and neighbourhood to Marathwada	Became less marked on 15
5.	At 1.5 km a.s.l.	14	From the cyclonic circulation over Punjab and neighbourhood to Jharkhand	Stationary	*In situ*	Became less marked on 15
6.	At 0.9 km above m.s.l.	19-20	West Vidarbha and neighbourhood to interior Odisha	Do	Do	Became less marked on 21
(**D**) *Trough in easterlies / Trough of low*						
1.	At 1.5 km above m.s.l.	25	From north interior Karnataka to south east	Stationary	*In situ*	Became less marked on 26
(**E**) *North-South troughs / Wind Discontinuity/other troughs*						
1.	At 0.9 km a.s.l.	3-4	North interior Karnataka to north Kerala	East	Vidarbha to Comorin area	Became less marked on 5
2.	Do	1-2	Cyclonic circulation over southwest Madhya Pradesh to the cyclonic circulation over coastal Karnataka	Stationary	*In situ*	Became less marked on 3
3.	At 5.8 kms a.s.l.	3	Roughly along Long. 90° E to the north of Lat. 26° N	Do	Do	Became unimportant on 4
4.	At 0.9 km a.s.l.	3-4	North interior Karnataka to north Kerala	East	Vidarbha to Comorin area	Became less marked on 5
5.	Between 1.5 and 2.1 km above m.s.l.	6	From Vidarbha to Rayalaseema	Stationary	*In situ*	Became less marked on 7
6.	At 0.9 kms a.s.l.	7	From the cyclonic circulation over central parts of south Uttar Pradesh to interior Tamil Nadu	Do	Do	Became less marked on 8

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
7.	At 0.9 kms a.s.l.	9-12	From Marathwada to south Tamil Nadu	East	From east Vidarbha to south Tamil Nadu	Became less marked on 13
8.	Do	13	From the cyclonic circulation over south Tamil Nadu and adjoining Comorin area to north interior Karnataka	Stationary	*In situ*	Became less marked on 14
9.	At 9.5 km a.s.l.	15	Roughly along Long. 80° E to the north of Lat. 20° N on 15	Do	Do	Became less marked on 16
10.	At 0.9 km a.s.l.	17	From north Tamil Nadu to east Vidarbha	Do	Do	Became less marked on 18
11.	Do	19-20	From the cyclonic circulation over west Vidarbha to north interior Tamil Nadu	East	From north interior Karnataka to south Tamil Nadu	Became less marked on 21
12.	Upto 1.5 km a.s.l.	21-24	From west Vidarbha to south Tamil Nadu	Oscillatory	From south Tamil Nadu to north Madhya Maharashtra	Became less marked on 25
13.	At 0.9 km a.s.l.	21-22	From southeast Bihar to north coastal Odisha	West	From east Bihar to east Vidarbha	Became less marked on 23
14.	Upto 0.9 km a.s.l.	25-26	From east-central Arabian Sea to south Madhya Pradesh	East	From south interior Karnataka to south Gujarat region	Became less marked on 27
15.	At 0.9 km a.s.l.	28 Mar to 3 Apr	From north Kerala to south Chhattisgarh	Oscillatory	From coastal Karnataka to Telangana	Became less marked on 3

of 1 person in Ganderbal district (Jammu-Kashmir) on 27th March. Due to heavy rain at least 28 houses damaged in Ramban district (Jammu-Kashmir) and massive landslide followed by incessant rains caused damage to National Highway, rendering hundreds of people homeless on 29th March.

3.2. *April*

3.2.1. *Weather and associated synoptic features*

The details of the weather systems during the month are given in Table 3 and the principal amounts of rainfall are given in Table 5.

The rainfall in the first fortnight was subdued especially over north and central India. Under the influence of low-level trough / wind discontinuity, isolated to scattered rainfall / thunderstorm activity was reported from parts of west, central and south peninsular India.

Movement of western disturbances and their induced systems, trough/ wind discontinuities in the lower levels, continuous moisture incursion due to favourable position of anticyclone in the Bay of Bengal, strong wind convergence in the lower levels and favourable upper level features caused scattered to fairly widespread rainfall / thunderstorms over the country in the second fortnight of the month. This surge in rainfall in the latter half of the month cut down the previous deficiency, normalizing the monthly rainfall and kept the maximum temperatures below normal.

TABLE 3

Details of the weather systems during April 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 5.8 & 9.5 km above m.s.l.	5-8	Northeast Iran and adjoining Afghanistan	Eastward	Along Long. 93° E to the north of Lat. 25° N	Initially it lay as a trough in mid and upper tropospheric westerlies with its axis at 5.8 km above m.s.l. ran roughly along Long. 55° E to the north of Lat. 32° N, on 5 night. It lay as a trough in mid-tropospheric westerlies with its axis at 5.8 km above m.s.l. running roughly along Long. 85° E to the north of Lat. 30° N on 9 the, along Long. 93°E to the north of Lat. 25° N on 10 and moved away eastwards in the evening of same day
2.	At 1.5 km above m.s.l.	12	West Afghanistan and neighbourhood	Northeast-ward	Along along Long. 72° E to the north of Lat. 32° N	Moved away on 16
3.	Between 3.1 and 3.6 km above m.s.l	17-21	Northeast Afghanistan and neighbourhood	Do	North Punjab and neighbourhood	Initially it lay as a trough in mid-tropospheric westerlies with its axis at 5.8 km above m.s.l. roughly along Long. 50° E to the north of Lat. 30° N on 16
4.	Up to 3.1 km above m.s.l.	28	Northwest Afghanistan and neighbourhood	Do	Roughly along Long. 80° E to the north of Lat. 28° N	Merged with the trough in westerlies roughly along Long. 89° E on 2 May
(*ii*)	*As a trough*					
1.	At 5.8 km above m.s.l.	5	Roughly along Long. of 64° E to Lat. of 32° N.	East	As a cyclonic circulation at 3.1 km above m.s.l. over north Pakistan and adjoining Afghanistan	Merged with the cyclonic circulation of western disturbance which lay over Afghanistan and adjoining Pakistan on 7
2.	Do	9-12	Roughly along Long. 64° E to the north of Lat. 34° N	Northeast-wards	Roughly along Long. 90° E to the north of Lat. 22° N	Moved away northeastwards
3.	Do	22-24	Roughly along Long. 66° E to the north of Lat. 34° N	Do	Roughly along Long. 85° E to the north of Lat. 30° N	Moved away northeastwards
4.	Do	27-30	Roughly along Long. 75° E to the north of Lat. 30° N	East	Roughly along Long. 90° E to the north of Lat. 25° N	Initially it lay as a cyclonic circulation lay over Afghanistan and neighbourhood at 1.5 km above m.s.l. on 25. Moved away eastwards
(*iii*)	*As an induced cyclonic circulation*					
1.	Up to 1.5 km above m.s.l.	7	South Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 8
2.	Between 0.9 and 1.5 km above m.s.l.	14-15	Central Pakistan and neighbourhood	East	Northwest Rajasthan	Became less marked on 16
3.	At 0.9 km above m.s.l.	17-18	Do	Do	North Rajasthan and neighbourhood	Became less marked on 19
(**B**)	*Other upper air cyclonic circulations*					
1.	At 1.5 km above m.s.l.	1	Haryana and neighbourhood	Stationary	*In situ*	Became less marked on 2

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 1.5 kms a.s.l.	1	Gangetic West Bengal and neighbourhood	Stationary	*In situ*	Became less marked on 2
3.	At 1.5 km above m.s.l.	2	North interior Odisha and neighbourhood	Do	Do	Became less marked on 3
4.	Do	3	South Madhya Maharashtra and neighbourhood	North-east	southwest Madhya Pradesh and adjoining north Vidarbha	Became less marked on 6
5.	Up to 1.5 km above m.s.l.	6	Marathwada and neighbourhood	Stationary	*In situ*	Became less marked on 7
6.	Do	7	South Madhya Pradesh and adjoining Vidarbha	Do	Do	Became less marked on 8
7.	At 1.5 km above m.s.l.	8	North Rajasthan and neighbourhood	Do	Do	Became less marked on 9
8.	Do	8	Northeast Madhya Pradesh and neighbourhood	Southeast	South Odisha and neighbourhood	Became less marked on 11
9.	Up to 0.9 km above m.s.l.	8	South coastal Odisha and neighbourhood	Stationary	*In situ*	Became less marked on 9
10.	Do	8	Northeast Bangladesh and neighbourhood	North	Sub-Himalayan West Bengal and Sikkim and neighbourhood	Became less marked on 12
11.	Do	10-11	Central Pakistan and adjoining west Rajasthan	Stationary	*In situ*	Became less marked on 12
12.	Between 4.5 and 5.8 km above m.s.l.	12-14	Southeast Arabian Sea off Kerala coast	Do	Do	Became less marked on 15
13.	At 0.9 km above m.s.l.	12-14	Gulf of Mannar off south Tamil Nadu coast	East	Comorin area and neighbourhood	Became less marked on15
14.	Do	12	East Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 14
15.	Up to 0.9 km above m.s.l.	15-19	West Bengal and adjoining Bangladesh	East	Northeast Assam and neighbourhood	Became less marked on 20
16.	Do	16-18	East Uttar Pradesh and neighbourhood	Do	Southeast Uttar Pradesh and neighbourhood	Became less marked on 19
17.	Do	20-21	East Madhya Pradesh and neighbourhood	North	Northeast Madhya Pradesh and neighbourhood	Became less marked on 22
18.	Do	21-22	Lakshadweep and neighbourhood	-	Lakshadweep-Maldives area	Became less marked on 23
19.	Do	23	West Vidarbha and neighbourhood	East	Chhattisgarh and neighbourhood	Became less marked on 26
20.	Do	23	South Assam and neighbourhood	Stationary	*In situ*	Became less marked on 24
21.	Do	24-26	Central parts of Rajasthan and neighbourhood	Northeast	Haryana and neighbourhood	Became less marked on 27

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
22.	Between 0.9 and 2.1 km above m.s.l.	24-26	West Uttar Pradesh and adjoining Haryana	Northeast	Northeast Madhya Pradesh and neighbourhood	Became less marked on 27
23.	Up to 2.1 km above m.s.l.	25-30	Meghalaya and neighbourhood	West	Sub-Himalayan West Bengal and Sikkim and neighbourhood	Merged with the trough in westerlies roughly along Long. 89° E to the north of Lat. 22° N on 1 May
24.	Between 1.5 and 2.1 km above m.s.l.	26-27	Comorin area and neighbourhood	Stationary	*In situ*	Became less marked on 28
25.	At 1.5 km above m.s.l.	27-30	Vidarbha and neighbourhood	East	South Odisha and neighbourhood	Became less marked on 1 May
26.	At 3.1 km above m.s.l.	28-29	East-central Arabian Sea off south Maharashtra coast	Stationary	*In situ*	Became less marked on 30
27.	Between 1.5 and 2.1 km above m.s.l.	28	Southeast Sri Lanka and neighbourhood	Do	Do	Became less marked on 29
28.	Up to 1.5 km above m.s.l.	30 Apr	Comorin area and neighbourhood	Do	Do	Became less marked on 1 May
(C)	*North-South troughs / Wind discontinuity/other troughs*					
1.	Up to 1.5 km above m.s.l.	7	From the cyclonic circulation over south Madhya Pradesh and adjoining Vidarbha to interior Tamil Nadu	Stationary	From Rayalaseema to south Tamil Nadu across south interior Karnataka	It extended up to 0.9 km above m.s.l. on 8
2.	At 0.9 km above m.s.l.	3	Comorin area to Rayalaseema	Do	From south interior Karnataka to west Vidarbha	Became less marked on 7
3.	Up to 0.9 km above m.s.l.	14-18	Northwest Uttar Pradesh to north coastal Odisha	East	From the cyclonic circulation over southeast Uttar Pradesh to the cyclonic circulation over south Assam	Became less marked on 19
4.	Do	13	Sub-Himalayan West Bengal and Sikkim to south coastal Odisha	Stationary	*In situ*	Became less marked on 14
5.	Do	21-24	From cyclonic circulation over northeast Madhya Pradesh to north interior Karnataka	East	From north Bihar to southeast Madhya Pradesh	Became less marked on 25
6.	At 7.6 km above m.s.l.	20	Roughly along Long. 64° E to the north of Lat. 34° N	Do	Roughly along Long. 70° E to the north of Lat. 34° N	It moved away northeastwards on 22
7.	At 0.9 km above m.s.l.	19-20	South Tamil Nadu to south Marathwada	Do	North coastal Karnataka to Marathwada	Became less marked on 21
8.	At 1.5 km above m.s.l.	24	North Bihar to southeast Madhya Pradesh	Stationary	*In situ*	Became less marked on 25
9.	At 0.9 km above m.s.l.	25	From the cyclonic circulation over Meghalaya to the cyclonic circulation over Chhattisgarh	Do	Do	Merged with the east-west trough from Assam to Punjab on 26

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**D**)	*Trough in easterlies*					
1.	At 0.9 km above m.s.l.	16-18	Equatorial Indian Ocean to southeast Arabian Sea off south Kerala coast	West	Equatorial Indian Ocean to Lakshadweep area	Became less marked on 19
(**E**)	*East-West trough*					
1.	At 0.9 km above m.s.l.	1	From the cyclonic circulation over east Rajasthan to east Madhya Pradesh	Stationary	*In situ*	Became less marked on 2
2.	Do	21	From the cyclonic circulation over northeast Madhya Pradesh to west Assam	Do	Do	It became less marked on 22
3.	Up to 0.9 km above m.s.l.	20	East Rajasthan to north Chhattisgarh	Do	Do	Became less marked on 21
4.	Up to 1.5 km above m.s.l.	26	Assam to Punjab	Do	Do	Became less marked on 27
(**F**)	*Trough in westerlies / Trough of low*					
1.	At 0.9 km above m.s.l.	2 -5	North Bihar to south Odisha	East	Sub-Himalayan West Bengal to south Odisha coast	It became less marked on 6
2.	At 7.6 km above m.s.l.	20 -21	Roughly along Long. 64° E to the north of Lat. 34° N	Do	Roughly along Long. 70° E to the north of Lat. 34° N	It moved away northeastwards on 22
3.	At 9.5 km above m.s.l.	21-22	Roughly along Long. 87° E to the north of Lat. 15° N	Do	Roughly along Long. 88° E to the north of Lat. 24° N	It became less marked on 23
4.	Between 2.1 and 3.6 km above m.s.l.	22	Roughly along Long. 88° E to the north of Lat. 24° N	Stationary	*In situ*	Became less marked on 23
5.	At 3.1 km above m.s.l.	24	Roughly along long. 89° E to the north of Lat. 24° N	East	Roughly along Long. 90° E to the north of Lat. 24° N	Became less marked on 26

3.2.2. *Temperature distribution*

(a) *Minimum temperatures*

The minimum temperatures over most parts of India were generally *normal* in the first week, followed by rise in temperatures to *above normal* to *appreciably above normal* over most of the country outside peninsular region corresponding with subdued rainfall activity over these regions. Most of the sub-divisions from east and north India experienced a drop in temperature to *appreciably to markedly below normal* in the last few days of the month with the increase in rainfall activity over most parts of the country.

(b) *Maximum temperatures*

Heat wave to *severe heat wave* conditions were observed at isolated pockets over Saurashtra & Kutch on 13th. Heat wave conditions were also observed at isolated pockets over Saurashtra & Kutch on 12th and 14th and at isolated pockets over Gujarat region on 13th.

The maximum temperatures in the first week were generally *normal / below normal* except over northeast India, where they were *above normal to appreciably above normal* over the country outside peninsular India. In the second fortnight of the month, there was a

TABLE 4

Details of the weather systems during May 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**) *Cyclonic storm / Depression*						
1.	Super Cyclonic storm 'AMPHAN'	16-21	Southeast Bay of Bengal and adjoining south Andaman	North-northeast	North Bangladesh and neighbourhood	Under the influence of cyclonic circulation over south Andaman sea and adjoining Sumatra coast, a low pressure area formed on 13. Details are given in the article on 'Storms and depression over north Indian Ocean 2020'
2.	Depression	29-31	South coastal Oman and adjoining Yemen	Stationary	*In situ*	Under the influence of cyclonic circulation over westcentral and adjoining southwest Arabian sea, a low-pressure area formed over westcentral Arabian Sea on 28. Details are given in the article on 'Storms and depression over north Indian Ocean 2020'
(**B**) *Low pressure*						
1.	Low Pressure Area	1-6	South Andaman Sea and adjoining southeast Bay of Bengal	Quasi-Stationary	*In situ*	Initially it lay as a cyclonic circulation extending between 0.9 and 3.6 km above m.s.l. over Malacca Strait and neighbourhood on 27 April It persisted over the same region between 0.9 and 5.8 km above m.s.l. on 28. It lay over north Sumatra and neighbourhood and extended up to 3.6 km above m.s.l. on 29. The cyclonic circulation extending up to 4.5 km above m.s.l. over north Sumatra and neighbourhood lay over south Andaman Sea and neighbourhood on 30 April
(**C**) *Western Disturbances / Eastward moving systems*						
(*i*) *Upper air cyclonic circulation*						
1.	Between 1.5 & 3.1 kms a.s.l.	9-11	Central Pakistan and neighbourhood	Quasi-Stationary	North Pakistan and neighbourhood	Initially it lay as a trough in westerlies with its axis at 3.1 kms a.s.l. roughly along Long. 55º E and Lat. 32º N on 7. Western disturbance moved away northeastwards on 12. However, associated trough aloft moved away northeastwards on 14
2.	Between 5.8 & 7.6 kms a.s.l.	23-25	East Afghanistan and adjoining Pakistan	East	North Pakistan and adjoining Jammu-Kashmir	Initially it lay as a trough with axis at 5.8 kms a.s.l. roughly along Long. 62º E and Lat. 25º N on 21. It moved away northeastwards on 26
3.	At 5.8 kms a.s.l.	26-28	Afghanistan and neighbourhood	Do	East Afghanistan and adjoining Pakistan	Then it lay as a upper level trough between 5.8 & 7.6 kms a.s.l. roughly along Long. 67º E and Lat. 25º N on 29 May which moved away eastwards on 2 June
(*ii*) *As a trough*						
1.	Between 2.1 & 4.5 kms a.s.l.	1-3	Along Long. 89° E to the north of Lat. 22° N	East	Along Long. 90° E to the north of Lat. 22° N	It moved away northeastwards on 4
2.	At 5.8 kms a.s.l.	3-9	Along Long. 64° E to the north of Lat. 33° N (axis at 5.8 kms a.s.l.)	Do	Along Long. 90° E to the north of Lat. 25° N	It moved away northeastwards on 10

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Mid & upper tropospheric levels	4	Along Long. 82° E to the north of Lat. 28° N (axis at 5.8 kms a.s.l.)	Stationary	*In situ*	It moved away eastwards on 5
4.	Mid tropospheric levels	13-20	Along Long. 55° E to the north of Lat. 26° N (axis at 5.8 kms a.s.l.)	East	Along Long. 82° E to the north of Lat. 25° N (axis between 5.8 & 7.6 kms a.s.l.)	Initially it lay as a cyclonic circulation between 1.5 & 3.1 kms a.s.l. over western parts of Iran and neighbourhood with trough aloft at 5.8 kms a.s.l. along Long. 50° E to the north of Lat. 30° N on 12. It merged with the cyclonic storm 'AMPHAN' on 21
5.	Do	22	Along Long. 88° E to the north of Lat. 23° N (axis at 5.8 kms a.s.l.)	Stationary	*In situ*	It moved away northeastwards on 23
6.	Between 1.5 & 3.1 kms a.s.l.	24	Along Long. 87° E to the north of Lat. 23° N	Do	Do	It moved away northeastwards on 25
7.	Do	25-26	Along Long.83° E to the north of Lat. 23° N	East	Along Long. 87° E to the north of Lat. 23° N	It moved away northeastwards on 27
(*iii*)	*An induced cyclonic circulation*					
1.	Upto 1.5 kms a.s.l.	29-31	Northwest Rajasthan and adjoining Pakistan	East	Haryana and neighbourhood	It became less marked on 1 June
(D)	*Other upper air cyclonic circulations*					
1.	At 1.5 kms a.s.l.	1	Central parts of south Madhya Pradesh and neighbourhood	Stationary	*In situ*	It became less marked on 2
2.	Upto 0.9 km a.s.l.	1-3	Southeast Uttar Pradesh and neighbourhood	Oscillatory	Northeast Madhya Pradesh and neighbourhood	It became less marked on 4
3.	Do	1-4	South Assam and neighbourhood	North	Northeast Bangladesh and neighbourhood	It became less marked on 5
4.	Upto 1.5 km a.s.l.	2-4	North Rajasthan and adjoining Haryana, Punjab	East	Haryana and neighbourhood	It became less marked on 5
5.	At 1.5 km a.s.l.	4	Southeast Arabian sea off Kerala coast	Stationary	*In situ*	It became less marked on 5
6.	Upto 0.9 kms a.s.l.	5	Southeast Madhya Pradesh and neighbourhood	Do	Do	It became less marked on 6
7.	Do	5-12	Southwest Rajasthan and neighbourhood	Oscillatory	West Rajasthan and neighbourhood	It became less marked on13
8.	Do	6	West Uttar Pradesh adjoining Haryana	Stationary	*In situ*	It became less marked on 7
9.	Do	6	East Uttar Pradesh adjoining Bihar	Do	Do	It became less marked on 7
10.	Do	6	Bangladesh and neighbourhood	Do	Do	It became less marked on 7
11.	Do	6	East Vidarbha and neighbourhood	Do	Do	It merged with the trough/wind discontinuity from Vidarbha to south Tamil Nadu on 7
12.	Between 2.1 & 4.5 kms a.s.l.	7-13	Comorin area and neighbourhood	Oscillatory	Comorin area and neighbourhood	Became less marked on 14

TABLE 4 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	Upto 1.5 kms a.s.l.	9-10	Meghalaya and neighbourhood	Oscillatory	Northeast Bangladesh and adjoining Meghalaya	Became less marked on 11
14.	Do	14-15	West Rajasthan and neighbourhood	East	East Rajasthan and neighbourhood	Became less marked on 16
15.	Upto 0.9 kms a.s.l.	14	Southern parts of Assam and neighbourhood	Stationary	*In situ*	Became less marked on 15
16.	At 1.5 kms a.s.l.	15	Maldives area and neighbourhood	Do	Do	Became less marked on 16
17.	Upto 0.9 kms a.s.l.	15	East Uttar Pradesh and neighbourhood	Do	Do	It became less marked on 16
18.	Do	16	West Madhya Pradesh and neighbourhood	Do	Do	It became less marked on 17
19.	Between 0.9 & 1.5 kms a.s.l.	16 17	North Pakistan and neighbourhood	East	East Pakistan and adjoining west Rajasthan	It became less marked on 18
20.	Upto 0.9 kms a.s.l.	16-18	East Bangladesh and adjoining Meghalaya	Stationary	*In situ*	It became less marked on 19
21.	Between 3.6 & 4.5 kms a.s.l.	17	Southeast Arabian Sea off Kerala coast	Do	Do	It became less marked on 18
22.	Upto 0.9 km a.s.l.	18	East Vidarbha and neighbourhood	Do	Do	It became less marked on 19
23.	Do	21-22	East Uttar Pradesh	Do	Do	It became less marked on 23
24.	At 1.5 km a.s.l.	23	Coastal Karnataka and neighbourhood	Do	Do	It became less marked on 24
25.	Upto 1.5 kms a.s.l.	23	North Pakistan and adjoining Punjab	Do	Do	It became less marked on 24
26.	Between 1.5 & 3.1 kms a.s.l.	24	Chattisgarh & neighbourhood	Do	Do	It merged with the trough in westerlies roughly along Long. 83° E to the north of Lat. 23° N on 25
27.	At 5.8 kms a.s.l.	24	Southwest Bay of Bengal and adjoining south Tamil Nadu	Do	Do	It became less marked on 25
28.	At 1.5 kms above m.s.l. a.s.l.	24-28	Southwest Rajasthan and neighbourhood	East	Northeast Rajasthan and neighbourhood	It became less marked on 29
29.	Between 3.1 & 5.8 kms a.s.l.	25-28	Southwest Bay of Bengal and neighbourhood	Quasi-Stationary	Southwest Bay of Bengal and adjoining south Sri Lanka coast	It became less marked on 29
30.	At 2.1 kms a.s.l.	26	Coastal Karnataka and neighbourhood	Stationary	*In situ*	It became less marked on 27
31.	Upto 3.1 km a.s.l.	28-29	South Assam and neighbourhood	Do	Do	It became less marked on 30
32.	Upto 1.5 km a.s.l.	29-30	Chhattisgarh and neighbourhood	Oscillatory	Central parts of Chhattisgarh and neighbourhood	It became less marked on 31
33.	Do	30	Lakshadweep area off Kerala coast	Stationary	*In situ*	It merged with the low pressure area over southeast and adjoining eastcentral Arabian Sea & Lakshadweep area on 31
34.	Do	30-31	Southeast Rajasthan and neighbourhood	Do	Do	It became less marked on 1 June

TABLE 4 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
35.	At 0.9 kms a.s.l.	30-31	Jharkhand and neighbourhood	Stationary	*In situ*	It became less marked on1 June
36.	Upto 0.9 km a.s.l.	31 May	Northeast Rajasthan and neighbourhood	Do	Do	It became less marked on 1 June
37.	At 1.5 km a.s.l.	31 May	Meghalaya and neighbourhood	Do	Do	Became less marked on 1 June
(E)	*East-West trough / shear zone*					
1.	Upto 2.1 kms a.s.l.	3-4	From the cyclonic circulation over north Rajasthan & adjoining Haryana, Punjab to southern parts of west Bengal	Oscillatory	From the cyclonic circulation over Haryana and neighbourhood to the cyclonic circulation over northeast Bangladesh and neighbourhood	It became less marked on 5
2.	At 0.9 kms a.s.l.	15	From the cyclonic circulation over east Uttar Pradesh and neighbourhood to south Assam	Stationary	*In situ*	It became less marked on 16
3.	Upto 1.5 km a.s.l.	26-27	From east Uttar Pradesh to Nagaland	Do	Do	It became less marked on 28
(F)	*Other troughs / Wind discontinuity*					
1.	Upto 0.9 kms a.s.l.	10	From cyclonic circulation over north Rajasthan to north Chhattisgarh	Stationary	*In situ*	It became less marked on 11
2.	Between 1.5 & 2.1 kms a.s.l.	11	East Bihar to north Chhattisgarh	Do	Do	It became less marked on 12
3.	Upto 0.9 kms a.s.l.	16-17	South Bihar to the cyclonic circulation over east Bangladesh and adjoining Meghalaya	Oscillatory	Sub Himalayan west Bengal to the cyclonic circulation over east Bangladesh and adjoining Meghalaya	It became less marked on 18
4.	At 0.9 kms a.s.l.	23-31	Southeast Madhya Pradesh to Telangana	Do	From the cyclonic circulation over Chhattisgarh to the cyclonic circulation over Lakshadweep area	Became less marked on 1 June

fall in temperature to *appreciably below normal / markedly below normal* over most of northwest and northeast India.

The month's highest maximum temperature recorded over the plains was 45.2 °C at Khargone (west Madhya Pradesh) on 7th April, 2020.

3.2.3. *Disastrous weather events*

According to media and other disaster reports, in the second fortnight of the month, thunderstorms damaged several houses, roadside hoardings, also uprooted electric poles and trees in many parts of Assam & Meghalaya. Two persons died after an under construction house collapsed in Rajouri district (Jammu) due to persistent rains. Lightning strikes caused death of 1 person in Rajouri district of Jammu, 6 persons at different places in Odisha, one farmer in Telangana, one girl in Andhra Pradesh, one elderly woman at Mookannur, Angamaly of Kerala and 3 persons in Kalaburagi district of Karnataka in the last week of the month. Thunderstorms related incidents killed 12 persons in Saran, Jamui and Bhojpur districts of Bihar. Heavy rain and lashing winds associated with the thunderstorm uprooted numerous trees and brought down overhead power lines in

TABLE 5

Some representative amounts of rainfall in cm for the months March, April and May 2020 (5 cm and above)

Date	Chief amounts of rainfall in cm
1 Mar	Tuting and Purushottampur 6 each, Pipili, Sankarankoil and Vizianagaram 5 each
2 Mar	Kothagiri 15, Coonoor 11, Bodinaickanur 5
3 Mar	Srungavarapukota 6, Pachmarhi 5
4 Mar	Nil
5 Mar	Midnapore and Midnapore Cwc 7 each, Mohanpur 6
6 Mar	Nil
7 Mar	Nil
8 Mar	Nil
9 Mar	Nil
10 Mar	Punalur 6
11 Mar	Nil
12 Mar	Nil
13 Mar	Nil
14 Mar	Nil
15 Mar	D.P.Ghat and Kotma 5 each
16 Mar	Tuting 15, Gurundia ARG 6
17 Mar	Nil
18 Mar	Deogarh and Batli ARG 6 each, Harabhanga, Barpalli ARG and Khowai 5 each
19 Mar	Pongkhuri Nsdma AWS 6
20 Mar	Nil
21 Mar	Kotagarh 7, Kollam Rly 6, Gangtok 5
22 Mar	Nil
23 Mar	Nil
24 Mar	Nil
25 Mar	Nil
26 Mar	Sankeshwar 7, Pooh 6
27 Mar	Nil

TABLE 5 (*Contd*.)

Date	Chief amounts of rainfall in cm
28 Mar	Port Blair 6
29 Mar	Nil
30 Mar	Nil
31 Mar	Mohol 6, Nancowry 5
1 Apr	Kailashahar 16, Kamalpur 14, Dharmanagar / Panisagar 12, Agartala AP and Arundhutinagar 7 each, Khowai, Gharmura, Alipurduar Cwc, Drf and Williamnagar 6 each, Nalbari / Pagladia, Manash Nh Xing, Barpeta, Hazuah, Kampur, Puthimari, Barapani, Sohra (Rkm), Beky Rly.Bridge and Bishalgarh 5 each
2 Apr	Sankalan 5
3 Apr	Dharmanagar / Panisagar 7, Belonia, Barpeta and Passighat 6 each, Sonamura, Bhalukpong and Beky Rly.Bridge 5 each
4 Apr	Nil
5 Apr	Jamkhandi, Drf and Annapurnaghat 5 each
6 Apr	Kapkot 6
7 Apr	Taibpur 16, Williamnagar 9, Goalparacwc, Pakuria and Goalpara 8 each, Bahadurganj and Thakurganj 7 each, Mohanpur, Goibargaon, Rampurhat (Drms) and Gaunaha 6 each, Kakinada, Shillong, Jaleswar, Galgalia, Tiring, Tribeniganj and Bhograi 5 each
8 Apr	Anandpur Sahib 7
9 Apr	Naraingarh 13, Cooch Behar 8, Mathabhanga 7, Munsyari 6, Kishanganj and Chargharia 5 each
10 Apr	Kalyani Smo 7, Sabroom 6, Dunguripalli, Canning Town, Arundhutinagar and N. Lakhimpur 5 each
11 Apr	Thenkasi 8, Shorapur 5
12 Apr	Nil
13 Apr	Damthang 9
14 Apr	Bahadurganj, Tuli Nsdma AWS and Sonbarsa 6 each, Longleng Nsdma AWS and Hasimara 5 each
15 Apr	Daparijo 5
16 Apr	Mathabhanga, Guwahati AWS and Guwahati AP 6 each
17 Apr	Khanpur 7, Shipgyar, Tribeni / Balmiki, Mandsaur - AWS and Atru 6 each, Kuzhithurai, Pechiparai, Anta, Arnod, Asnawar, Dug, Drf, Goibargaon, Kodaikanal, Udhampur IAF, Bassi and Sheopur 5 each
18 Apr	Parumbikulam, Dalhousi Alha AWS, Ramannapeta, Budaun, Shipgyar, Fatehgarh Sahib and Sirhind 5 each
19 Apr	Enamakkal and Markapur 8 each, Chintamani PTO and Gaisilet ARG 7 each, Yadagirigutta and Vadakkancherry 6 each, Raikia ARG, Raptadu, Aluva Pwd, Kodungallur and Palakkad 5 each
20 Apr	Parumbikulam, Ambalavayal and Kodaikanal 7 each, Tarva ARG; 5 - Mavelikara, Konni and Kurudamannil 6 each
21 Apr	Venkatagiri 11, Uthagamandalam 10, Hosur, Maheswaram, Valparai, Omalur and Mettur 7 each, Coonoor, Narmetta, Barur and Srungavarapukota 6 each, Vadakkancherry, Merakamudidam, Kollamkode and Kuppady 5 each

TABLE 5 (*Contd*.)

Date	Chief amounts of rainfall in cm
22 Apr	Gangtok 6, Tadong, Kashinagar, Karanjia, Pipili and Thakurmunda 5 each
23 Apr	Attur 10, Mysuru 9, Periyakulam, Piravam, Thammampatty, Sankaridurg and Kolar Gold Field 6 each, Kochi AP, Gudalur, Mettur, Tiruvannamalai, Hosur, Kozhikode and Parumbikulam 5 each
24 Apr	Nandigama 9, Sukinda 7, Kamakhyanagar and Dhanbad 6 each, Keeranur 5
25 Apr	Minicoy 7, Banjar 6
26 Apr	Konni 6
27 Apr	Nil
28 Apr	Karimganj 12, Chengmari / Diana 11, Gharmura 8, Hasimara 7, Kokrajhar 6, B P Ghat 5
29 Apr	Kokrajhar 13, Dhubri 7, Hazuah and Thodupuzha 6 each, Drf and Tikrikilla 5 each
30 Apr	Melabazar / Matunga 16, Drf 14, Cherrapunji 13, Numaligarh 12, Nahar Katia 9, Sivasagar 8, Bihubar, Davanagere PTO and Yelburga 7 each, Naharlagun and Williamnagar 6 each, Dillighat, Khowang, Miao and Majbhat 5 each
1 May	Sohra(Rkm) 22, Sohra 20, Mawsynram 16, Goalparacwc, Haflong and Gossaigaon 10 each, Bargur, Barpeta, Aie Nh Xing and Melabazar / Matunga 9 each, Tadong, Hawai and Miao 8 each, Goibargaon, Beky Rly.Bridge, Kokrajhar, Manash Nh Xing, Drf, Nalbari / Pagladia and Maya Bandar 7 each, Alipurduar, Barobhisha, Settur, Tezu, Rolla, Tinsukia, Gowribidanur, Dholla Bazar, Bahalpur and Puthimari 6 each, Panbari, Gangtok, Nongstoin, Kayamkulam Agri, Jorhat, Periyapatna, Alur, Nahar Katia, Karimganj, Neamatighat, Moranhat, Kumargram, Majbhat, C Belagal and Golaghat 5 each
2 May	Tizit Nsdma AWS, Sohra (Rkm) and Mawsynram 14 each, Sohra 10, Bahalpur, Nongstoin and Dholla Bazar 9 each, Hawai, Margherita and Tuli Nsdma AWS 8 each, Haflong, Majbhat, Dillighat, Khowang, Tamulpur and Dhubri 7 each, Dhubri Cwc, Miao, Konijerla, Manash Nh Xing and Tezu 6 each, Bihubar, Goibargaon, Goalparacwc, Kokrajhar, Moranhat, Puthimari, Drf, Koloriang, Numaligarh, Mathabhanga, Jorhat, Naharlagun, Nahar Katia, Changlang, Barpeta and Itanagar 5 each
3 May	Berhampur 30, Ichchapuram 18, Gopalpur, Sompeta and Banki ARG 17 each, Gossaigaon 16, Chhatrapur and Palasa 15 each, Galgalia 14, Mandasa 13, Mundali and Tekkali 12 each, Purushottampur, Mohana, Puri, Ranpur and R.Udaigiri 11 each, Kokrajhar and Rajghat 10 each, Kalingapatnam, Nuagada ARG and Nongstoin 9 each, Digapahandi ARG, Tirtol ARG, Hawai, Balasore and Gania ARG 8 each, Banpur, Alipurduar, Aska, Nh5 Gobindpur, Khandapara, Narsinghpur, Naraj, Niali ARG and Hazuah 7 each, Tangi, Kantapada ARG, Nimpara, Bhubaneshwar AP, Kumargram, Alipingal and Odagaon ARG 6 each, Cooch Behar, Bolagarh ARG, Nayagarh, Daspalla, Long Islands, Ranastalam, Nilgiri, Muniguda ARG, Hindol, Soro and Tikrikilla 5 each
5 May	Sohra (Rkm) 41, Mawsynram 33, Sohra 28, Williamnagar 17, Sholingur 14, Shillong and Tamenglongi 13 each, Guwahati City; 9 - Kheronighat, Sabroom and Barapani 11 each, Guwahati AP, Dharamtul, Barpathar and Kampur 8 each, R.K. Pet, Jia Bharali N T Xing, Bhandari Nsdma AWS, Bokajan, Karimganj, Shella and Numaligarh 7 each, Udaipur, Goibargaon, Tezpur and Ong Pangkong Nsdma AWS 6 each, Dimapur Nsdma AWS, Goalpara, Majbhat, Golaghat, Barpeta, Golaghat Cwc, N. Lakhimpur, Naharlagun, Badatighat and Haflong 5 each
6 May	Uthangarai 8, Khliehriat 7, Mangan and Sankalan 6 each, Passighat, Vellore, Panbari, Aie Nh Xing, Manash Nh Xing, Chungthang, Palasamudram and Chauldhowaghat 5 each
7 May	N. Lakhimpur 9, Dhemaji and Beki Mathungari 7 each, Chauldhowaghat and Naharlagun 6 each, Hazuah, Khanitar, Anini and Tiruppur 5 each
8 May	Tirukoilur 9, Nelamangala 7, Madurai City and Mayanur 6 each, Kancheepuram and Tadong 5 each
9 May	Padalur, Moranhat and Nahar Katia 6 each, Dibrugarh AP, Dholla Bazar and Krishnarajasagara 5 each
10 May	Buxaduar 10, Tezu 9, Sohra and Sivasagar 7 each, Goibargaon, Melabazar / Matunga, Barpeta and Drf 6 each, Moranhat, Manash Nh Xing, Margherita, Gangtok and Sohra(Rkm) 5 each

TABLE 5 (*Contd.*)

Date	Chief amounts of rainfall in cm
11 May	Sohra (Rkm) 15, Sohra 13, Mawsynram 12, Miao 7, Dillighat, Nahar Katia and Manash Nh Xing 6 each, Hasimara, Moranhat, Roing, Margherita, Dholla Bazar, Itanagar, Naharlagun and Aie Nh Xing 5 each
12 May	Buxaduar 13, Miao 11, Namsai 10, Tinsukia 9, Dholla Bazar 8, Kothagiri, Puthimari and Tezu 7 each, Chinthakam, Dibrugarh AP, Williamnagar, Jaipatna, Koraput, Periyapatna and Kanjirappally 5 each
13 May	Yingkiong 14, Anini and Dholla Bazar 9 each, Miao, Shiv, Namsai and Konni 6 each, Tezu, Passighat and Naharlagun 5 each
14 May	Sohra (Rkm) 9, Abhayapuri AWS, Maddur, Beki Mathungari, Tuting and Shoolagiri 6 each, Dumka, Rentachintala, Jangamaheswarapuram and Roing 5 each
15 May	Mawsynram 7, Tibi 6
16 May	Car Nicobar 19, Gharmura 10, Arundhutinagar 7, Dharmanagar / Panisagar, Kandaghat and Silchar 6 each, Williamnagar, Gautam Buddha Nagar, Thakurmunda, Mon Sadar Nsdma AWS, Matijuri and Marandahalli 5 each
17 May	Gossaigaon 7, Gharmura 6, Aie Nh Xing, Manash Nh Xing, Rangiya and Kokrajhar 5 each
18 May	Kamalpur 10, Dharmanagar / Panisagar and Hissar 7 each, Alipurduar, Kailashahar, Ghumarwin, Beky Rly.Bridge and Goalparacwc 6 each, Khowai, Dalhousi Alha AWS, Udhampur IAF, Gundala, Williamnagar and Sohra 5 each
19 May	Koloriang 5
20 May	Yingkiong 7, Dillighat, Chickmagalur and Badatighat 5 each
21 May	Kumargram and Falakata 6 each, Hut Bay 5
22 May	Hakimpet and Cherrapunji 7 each, Pharasgaon, Mokokchang, Goalpara, Alipurduar, Jamkhandi, Jorhat and Tadong 5 each
23 May	Annapurnaghat 10, Drf and Sohraeach 8, Tezpur, Golaghat, Rajmahal, Jia Bharali N T Xing, Silchar and Gossaigaon 7 each, Mathabhanga, Gaunaha, Goibargaon and Majbhat 6 each, Mawsynram, Melabazar / Matunga, Lakhipur, Dhekiajuli, Golaghat Cwc and B P Ghat 5 each
24 May	Kailashahar 25, Kolasib 17, Dharmanagar / Panisagar 15, Mangan 10, Gharmura 8, Kabi, Sankalan, Lengpui and Thiruvananthapuram 6 each, Gangtok and Nargund 5 each
25 May	Gyalsing PTO 11, Thiruvananthapuram AP 9, Sabroom, Ramanagara and Thiruvananthapuram 7 each, Kottayam, Lengpui, B P Ghat and Kokrajhar 6 each, Car Nicobar, Hassan, Khowai, Kohima, Tadong, Kozha, Agartala AP, Aie Nh Xing, Lower Kothaiyar ARG, Dharmanagar / Panisagar, Bahalpur and Jharnapani 5 each
26 May	Sankalan 17, Miao 16, Mangan 14, Passighat 10, Dholla Bazar 7, Chungthang 6, Rangiya and Changlang 5 each
27 May	Kamalpur 10, Alipurduar and Bhalukpong 7 each, Thondebhavi, Gangtok and Jia Bharali N T Xing 6 each, Pedong, G Bazar, Bengaluru Kial, Allagadda, Khowang, Passighat, Badatighat and Gooty 5 each
28 May	Barpeta 9, Beky Rly. Bridge 8, Tamulpur 7, Hazuah, Gangtok and Beki Mathungari 6 each, Tadong, Williamnagar, Nalbari / Pagladia and Mangan 5 each
29 May	Chengmari / Diana 9, Majitar and Rampurhat (Drms) 8 each, Nagarkata 7, Gunupur, Dabugan ARG, Kovai / Koyamutthur AP and Murti 6 each, Raikia ARG, Pollachi, Penucondapuram, Sonepur, Mandya, Daringibadi, Ponnani, Khanitar, Mainpur, Gudari and Seethanagaram 5 each
30 May	Raptadu, Rajmahal and Gudalur 9 each, Aryankavu 8, Jagdalpur, Hazuah and Anantpur 6 each, Kursela, Araku Valley, Punalur, Majitar, Damthang and Bonakal 5 each
31 May	Bihpur 8, Dhengbridge 7, Katoria and Usilampatti 6 each, Hosur, Araria, Mulanur, Pochampalli, Bihar Shrif, Majitar and Purnea 5 each

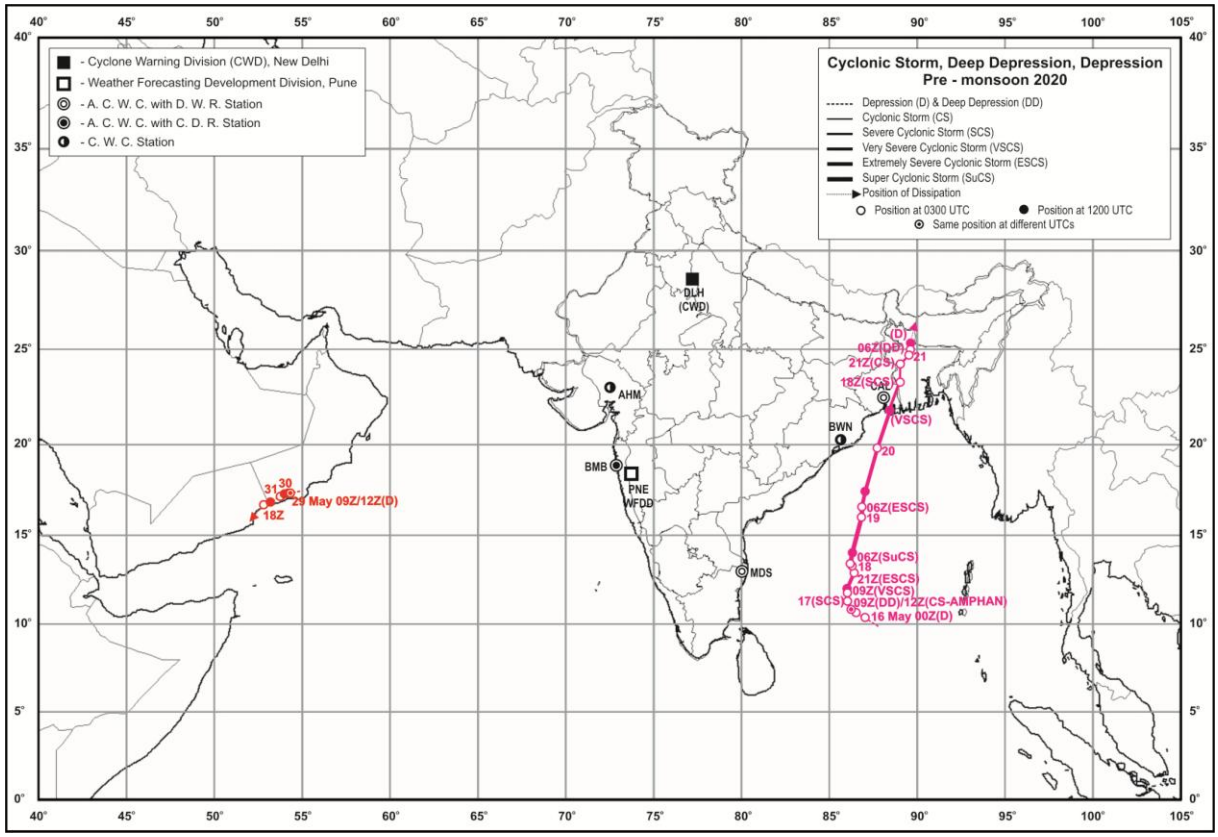

Fig. 2. Track of cyclonic storm, deep depression and depression during pre-monsoon season 2020

Thiruvananthapuram, Kollam, Ernakulam and Idukki districts of Kerala. Flash floods in the last few days of the month triggered by heavy rains took toll of 2 each in Shopian and Budgam districts of Kashmir. Massive rain and hailstorm caused huge damage to the crops and various kinds of vegetables in different areas of Shopian district.

3.3. *May*

3.3.1. *Weather and associated synoptic features*

(a) *Advance of southwest monsoon*

In view of strengthening and deepening of cross equatorial flow as well as enhanced cloudiness and rainfall, the southwest monsoon advanced into some parts of south Bay of Bengal, Nicobar Islands and Andaman Sea on 17th May. Its further advance was hindered by the formation and intensification of the SuCS, "AMPHAN" over the Bay of Bengal. The monsoon current further advanced into some more parts of South Bay of Bengal, most parts of Andaman Sea and Andaman & Nicobar Islands on 27th May. It advanced into Kerala on 1st June coinciding with its normal date of onset.

(b) *Other synoptic features and rainfall*

The details of weather systems and its track during the month are given in Table 4 and Fig. 2. The principal amounts of rainfall are given in Table 5.

The Super Cyclonic Storm (SuCS) "AMPHAN" originated from the remnant of a low pressure area which formed in the near equatorial easterly wave over south Andaman Sea and adjoining southeast Bay of Bengal. Under favourable environmental conditions, it concentrated gradually into a Super Cyclonic Storm (SuCS) around noon (0600 UTC) of 18th May. The system crossed West Bengal-Bangladesh coasts as a very severe cyclonic storm across Sundarbans. The system maintained the cyclonic storm intensity for almost 15 hours after landfall from 1200 UTC of 20th May to 0300 UTC of 21st May. Under the influence of this system heavy to very heavy rainfall occurred at a few places over coastal Odisha and Gangetic West Bengal on 20th and 21st May, heavy rainfall at isolated places over

Gangetic West Bengal, Assam, Meghalaya, Arunachal Pradesh, Sikkim, Nagaland, Manipur and Mizoram on 22nd May.

Apart from the above system, one depression formed over south coastal Oman and adjoining Yemen (29th May - 1st June) though it did not affect Indian coasts. Besides these systems a low pressure area formed over south Andaman Sea and adjoining Southeast Bay of Bengal on 1st May and became less marked on 6th May.

Some of the stations received record 24-hour rainfall in this month. A list of stations is given below with their previous record and date.

3.3.2. *Temperature distribution*

Movement of western disturbances, their interaction with strong easterlies in the lower levels supported by moisture incursion from the Bay of Bengal and Arabian Sea, troughs / wind discontinuities in the lower levels and the low pressure area with the associated cyclonic circulation extending up to mid tropospheric level, which formed over south Andaman Sea and adjoining southeast Bay of Bengal in the first fortnight caused scattered to fairly widespread rain / thundershowers over major parts of India, that kept the maximum temperatures *normal to below normal* over northwest, central and eastern part of India in the first two weeks of the month. It was only in the last week that the prevailing strong and dry northwesterly winds caused heat wave to severe heat wave conditions over plains of northwest India, central India, over parts of east and west India. *Severe heat wave* conditions were observed at many parts over west Rajasthan (24th, 25th & 27th May) and at isolated pockets over east Rajasthan on 27th May. *Heat wave* conditions with *severe heat wave* conditions were observed at isolated pockets over Gujarat state (24th & 25th) and Vidarbha (23rd - 25th, 27th & 29th); *heat wave* conditions were observed in some parts over west Madhya Pradesh (22nd - 25th & 27th), Telangana (23rd, 24th & 27th), Haryana, Delhi and Uttar Pradesh (24th, 25th & 27th), Chhattisgarh 923rd & 24th), Marathwada (24th) and Madhya Maharashtra (23rd &24th).

The month's as well as the season's highest maximum temperature of 50 °C was recorded at Churu (west Rajasthan) on 26th May.

3.3.3. *Disastrous weather events and damage*

Movement of western disturbances and their interaction with strong easterlies in the lower levels supported by moisture incursion from the Bay of Bengal and Arabian Sea caused scattered to fairly widespread rain or thundershowers over western Himalayan region and isolated to scattered rain or thundershowers over adjoining plains of northwest India and northern parts of central India. As per media reports heavy rains followed by hailstorm hit scores of villages of Uri and Boniyar tehsils of Baramulla district, few villages in Budgam, in Pahalgam belt of Anantnag district Kupwara and Rajouri districts in Kashmir, damaging crops and causing huge loss to apple orchards and Walnut trees in the first week. Thunderstorms and Lightning claimed about 157 livestock during this period in Kashmir. In the first week, cloudburst caused death of 2 women in Kishtwar district of Jammu, snow avalanche near Zoji La pass in Kashmir caused death of 1 person. Thunder storm took toll of at least 37 persons in 15 districts of Bihar including Aurangabad, Gaya, Kaimur, Rohtas, Arwal. Due to duststorm, 14 persons died from Alwar, Churu, Jaipur, Karauli, Kota, Dholpur and Tonk districts of Rajasthan in different incidences. Duststorm took toll of 4 people in Sepau districts of Rajasthan. Rain, accompanied with thunder, lightning and gusty winds, lashed many parts of Yadgir district in Karnataka State late on 9th night, due to which 6 livestock perished in Gurmitkal and Wadgera taluks and portions of several houses collapsed. It also caused damage to majority of standing paddy crops and horticulture crops including papaya and banana in several hectares, particularly in Shahapur taluka. At least 72 people were killed across 15 districts of Uttar Pradesh and 38 districts were also heavily affected by rains and hailstorms that lashed several parts of the state in the second and third week of May.

The trough or wind discontinuities caused isolated to scattered rainfall or thunderstorm activity over parts of central, west and south peninsular India along with isolated heavy rainfall activity over south peninsular India and isolated hail storm activity over parts of central India during the second week of the month. Due to lightning 1 person died in rural areas of Kozhikode in Kerala on 17th afternoon, a farmer died near Chittoor in Andhra Pradesh and a farmer and his 2 daughters were killed on the spot when lightning struck them in Gangavaram district, a man was struck dead by lightning in Anantapur district of Andhra Pradesh at the end of the month. Also 2 people died in Udupi district of Karnataka and 2 in Denkanikottai of Krishnagiri district in Tamil Nadu. A Man died as boat capsized due to strong winds near Tannirbavi of Mangaluru district in Karanataka.

Two (2) persons reportedly died from Gaya districts of Bihar due to heat wave on 25th May. Heavy rains caused flooding and landslides which killed 1 person in Sikkim. Gale wind force associated with the windstorm took toll of 3 people in different incidents of Anantnag

and Shopian districts in Kashmir on 27th May. Due to heavy rains and flash floods 6 persons died from Goalpara, Hojai and Nagaon districts of Assam during the period 28th to 31st May.

Due to heavy rain and high-velocity winds associated with SuCS, "AMPHAN", in all total 90 persons reportedly died. Out of which, at least 86 people were from East Midnapur, North 24 Parganas, South 24 Parganas, Kolkata, Hooghly and Howrah districts of West Bengal. Four persons and nearly 4000 livestock perished from Odisha. Damage to about 88,000 hectares of rice fields and 2,00,000 hectares of vegetable and sesame crops also reported. Thousands of mud houses were damaged. Several trees and electric poles were uprooted during the period of 16th to 21st May.

Acknowledgment

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Appendix

Definitions of the terms given in '*Italics*'

Temperatures

Heat Wave — Heat wave is considered if maximum temperature of a station reaches at least 40 °C or more for Plains and at least 30 °C or more for Hilly regions.

(a) *Based on Departure from Normal*

Heat Wave - Departure from normal is 4.5 °C to 6.4 °C

Severe Heat Wave - Departure from normal is >6.4 °C

(b) *Based on Actual Maximum Temperature*

Heat Wave - When actual maximum temperature ≥ 45 °C

Severe Heat Wave - When actual maximum temperature ≥47 °C

(d) *Criteria for describing Heat Wave for coastal stations*

When maximum temperature departure is 4.5 °C or more from normal, Heat Wave may be described provided actual maximum temperature is 37 °C or more.

To declare heat wave, the above depicted criteria should be met at least in 2 stations in a Met. sub-division for at least two consecutive days and it will be declared on the second day.

Temperature

(a) *Maximum/day temperatures*

Markedly above normal - 5.0 °C or more

Appreciably above normal - 3.1 °C to 5.0 °C

Above normal - 1.6 °C to 3.0 °C

Normal - 1.5 °C to –1.5 °C

(b) Minimum / Night temperature

Based on the revised criteria which came into practice with effect from 2016, cold waves are declared based on the actual minimum temperatures. Cold wave is considered when the minimum temperature of a station is 10 °C or less for plains and 0 °C or less for hilly regions. Also to declare cold wave, the criteria should be met at least in 2 stations in a met subdivision for at least 2 consecutive days.

Severe cold wave conditions - When the negative departure of minimum temperature from normal is more than -6.4 °C or when the actual minimum temperature is ≤ 2 °C over the plains

Cold wave conditions - When the negative departure of minimum temperature from normal is 4.5 °C to 6.4 °C or when the actual minimum temperature is ≤ 4 °C over the plains. For stations located over the coastal areas, when the minimum temperature departure is –4.5 °C or more, 'Cold Wave' may be described if the actual minimum temperature is 15 ° C or less

Cold day to severe cold day conditions - When the minimum temperature is 10 °C or less for plains and 0 °C or less for hilly regions. Cold day may be described if the departure of maximum temperature is -4.5 °C to –6.4 °C and severe cold day when it is less than 6.4 °C

Markedly below normal - when the departure from normal is –5 °C to or less

Appreciably below normal - when the departure from normal is between –3.1 °C to –5.0 °C

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

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

Rainfall

Heavy - 64.5 to 115.5 mm

Very Heavy - 115.6 to 204.4 mm

Large Excess - Percentage departure from normal rainfall is + 60% or more

Excess - Percentage departure from normal rainfall is + 20% to +59%

Normal - Percentage departure from normal rainfall is +19% to –19%

Deficient - Percentage departure from normal rainfall is –20% to –59%

Large Deficient - Percentage departure from normal rainfall is –60% or less

No rain - –100%