MAUSAM, **70**, 2 (April 2019), 371-396

Weather in India

HOT WEATHER SEASON (March-May 2018)†

1. Chief features

(*i*) The first cyclonic storm of the season, 'Sagar' (17-20 May) formed over the Gulf of Aden, followed by an extremely severe cyclonic storm, 'Mekunu' (21-26 May) over the Arabian Sea. A deep depression one each in the month of March and May formed over the Arabian Sea and Bay of Bengal respectively. Apart from these systems, one well marked low pressure area also formed over southeast Arabian Sea off Kerala-Karnataka coast during the month of May.

(*ii*) *Heat wave conditions** were observed over northern, northwestern and central parts of the country during the last week of March (26-31 March). In the month of April, heat wave conditions were observed over some parts of west Rajasthan in the first week and over Madhya Pradesh, Vidarbha and Saurashtra & Kutch only on few days during the last week. These conditions were more frequent and intense over Vidarbha, west Rajasthan and Madhya Pradesh and a few days over parts of west Uttar Pradesh, Haryana, east Rajasthan and Saurashtra & Kutch in the second fortnight of May.

(*iii*) There were occurrences of thunderstorms, squalls and hailstorms over east and north eastern regions, central India, some parts of northern India and peninsula. More hailstorms occurred in the second fortnight of April over east and northeast India. Thunderstorm activity wreaked havoc over north and northwest India in the first week of May.

(*iv*) Rainfall activity over the country during the season as a whole was normal [93% of Long Period Average (LPA) value]. It was *below normal* during March (53% of LPA) and normal during April and May (103% and 104% of LPA respectively).

(*v*) The Southwest Monsoon advanced into some parts of south Andaman Sea and southeast Bay of Bengal on 25th May and advancing rapidly set in over Kerala on 29th May (three days prior to 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, 2018 are also depicted in Fig. 1.

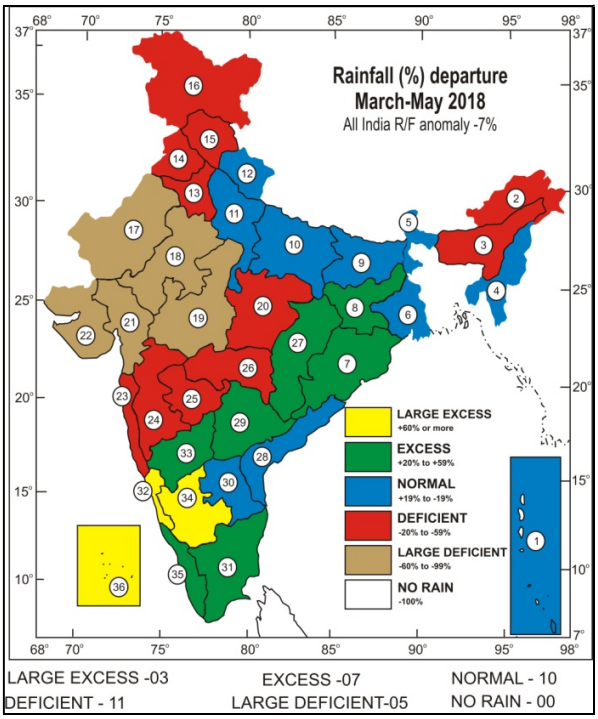

Fig. 1. Sub-divisional rainfall percentage departures (based on Operational data) for the season March-May, 2018. Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	4	**7**	20	**13**	-36	**19**	-66	**25**	-50	**31**	24
2	-23	**8**	34	**14**	-53	**20**	-41	**26**	-42	**32**	83
3	-21	**9**	-13	**15**	-42	**21**	-97	**27**	28	**33**	44
4	7	**10**	8	**16**	-26	**22**	-96	**28**	0	**34**	61
5	4	**11**	-8	**17**	-75	**23**	-35	**29**	23	**35**	37
6	3	**12**	-12	**18**	-60	**24**	-58	**30**	7	**36**	156

The depression in the southeast Arabian Sea and adjoining equatorial Indian Ocean caused heavy precipitation from 14 to 19 March over many sub divisions of the peninsula with heavy rain at a few places and very heavy rain at isolated places on one or two days over subdivisions of Karnataka and Kerala. The rest of the country other than the peninsular region remained highly

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

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TABLE 1

Sub-division wise rainfall (mm) for each month and season as a whole (March-May 2018) (based on operational data)

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.	Andaman & Nicobar Islands	21.5	25.0	-14	90.0	81.5	10	372.5	358.5	4	483.9	465.0	4
2.	Arunachal Pradesh	139.5	179.7	-22	150.7	278.8	-46	269.9	291.9	-8	577.2	750.4	-23
3.	Assam & Meghalaya	72.1	77.7	-7	142.3	181.2	-21	255.2	331.3	-23	466.7	590.2	-21
4.	Naga., Mani., Mizo. and Tri.	33.3	76.8	-57	113.4	149.4	-24	331.1	267.9	24	528.0	494.1	7
5.	Sub-Himalayan West Bengal & Sikkim	62.7	63.6	-1	127.9	123.7	3	286.1	269.8	6	476.7	457.1	4
6.	Gangetic West Bengal	4.0	28.0	-86	78.4	42.1	86	87.8	94.7	-7	170.2	164.8	3
7.	Orissa	1.1	27.0	-96	72.8	37.5	94	88.1	70.2	25	162.0	134.7	20
8.	Jharkhand	1.3	17.1	-92	51.7	18.4	181	52.2	43.9	19	106.5	79.4	34
9.	Bihar	1.6	10.1	-84	21.7	16.3	33	44.1	51.1	-14	67.4	77.5	-13
10.	East Uttar Pradesh	0.2	9.1	-97	14.5	5.6	158	19.6	17.0	15	34.3	31.7	8
11.	West Uttar Pradesh	1.4	11.3	-87	13.5	4.6	193	11.8	13.2	-10	26.7	29.1	-8
12.	Uttaranchal	24.5	57.6	-57	61.3	33.3	84	51.4	65.1	-21	137.2	156.0	-12
13.	Haryana, Chandigarh & Delhi	0.4	12.7	-97	10.6	7.5	42	11.0	14.0	-21	22.0	34.2	-36
14.	Punjab	5.1	25.3	-80	12.9	12.5	3	7.2	15.7	-54	25.2	53.5	-53
15.	Himachal Pradesh	37.5	114.2	-67	58.5	65.4	-11	47.3	65.3	-28	143.2	244.9	-42
16.	Jammu & Kashmir	59.9	151.9	-61	122.0	97.5	25	60.5	76.6	-21	242.7	326.0	-26
17.	West Rajasthan	0.2	3.8	-96	1.0	4.2	-76	3.7	11.1	-67	4.9	19.1	-75
18.	East Rajasthan	0.3	3.7	-92	4.3	2.9	49	2.3	10.8	-79	6.9	17.4	-60
19.	West Madhya Pradesh	0.5	4.6	-90	2.2	2.0	12	1.9	6.9	-72	4.6	13.5	-66
20.	East Madhya Pradesh	0.3	12.5	-98	8.5	5.5	54	6.0	7.1	-16	14.7	25.1	-41
21.	Gujarat region	0.0	1.1	-100	0.2	0.3	-45	0.0	5.3	-99	0.2	6.7	-97
22.	Saurashtra & Kutch	0.0	1.2	-100	0.1	0.2	-26	0.0	2.6	-100	0.1	4.0	-96
23.	Konkan & Goa	0.9	0.0	9220	2.3	2.8	-20	21.2	34.4	-39	24.3	37.2	-35
24.	Madhya Maharashtra	0.5	2.7	-83	5.3	8.9	-40	10.1	26.2	-62	15.8	37.8	-58
25.	Marathawada	1.7	5.7	-71	8.9	6.5	37	4.7	18.1	-74	15.3	30.3	-50
26.	Vidarbha	2.1	12.0	-83	9.3	7.7	20	6.6	11.2	-41	17.9	30.9	-42
27.	Chattisgarh	0.5	12.7	-96	26.1	14.4	81	33.3	19.7	69	59.8	46.8	28
28.	Coastal Andhra Pradesh	10.2	11.1	-8	34.8	21.8	59	52.1	64.1	-19	97.0	97.0	0
29.	Telangana	5.4	10.2	-47	23.6	16.4	44	40.2	29.7	35	69.3	56.3	23
30.	Rayalaseema	25.6	6.5	294	11.4	19.9	-43	51.2	55.6	-8	88.1	82.0	7
31.	Tamil Nadu	25.8	18.3	41	25.1	42.3	-41	107.7	67.5	60	158.6	128.1	24
32.	Coastal Karnataka	21.6	4.1	427	32.4	28.1	15	273.6	146.6	87	327.5	178.8	83
33.	North interior Karnataka	8.4	5.2	62	30.9	25.6	21	83.5	54.3	54	122.8	85.1	44
34.	South interior Karnataka	29.8	8.5	251	36.8	43.8	-16	167.0	92.9	80	233.7	145.2	61
35.	Kerala	47.5	30.4	56	117.6	109.5	7	356.6	239.8	49	521.8	379.7	37
36.	Lakshadweep	155.3	11.8	1216	47.2	48.9	-3	393.3	171.7	129	595.8	232.4	156

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

TABLE 2

Details of the weather systems during March 2018

S. No.	System	Duration	Place of initial location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Depression/Deep depression*					
1.	Depression	13 (0300 UTC)-17	Southeast Arabian Sea adjoining equatorial Indian Ocean near Lat. 5.0° N/Long. 76.0° E	North northwest	Area over Lakshadweep and adjoining southeast Arabian Sea	Details are given in the article on Storms & Depressions over the north Indian Ocean - 2018
(**B**)	*Western disturbances/Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	Upper air	10-13	Eastern parts of Afghanistan and neighbourhood	Northeast	Northern parts of Jammu & Kashmir	It moved away east northeastwards
2.	Mid tropospheric levels	13-14	North Pakistan and Jammu & Kashmir	East northeast	-	It moved away east-northeastwards
3.	Do	13-17	Along Long. 45° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	Do	Northeastern parts of Jammu & Kashmir and neighbourhood	Initially, it lay as a trough in mid-tropospheric westerlies with its axis at 3.1 kms a.s.l. extending along Long. 52° E to the north of Lat. 30° N on 12th. It moved away along with the trough aloft in mid and upper tropospheric westerlies along Long. 72° E
4.	Upto 0.9 kms a.s.l.	9-12	South Pakistan and adjoining west Rajasthan	East	Southwest Rajasthan and neighbourhood	Became less marked on 13
5.	Low pressure (associated cyclonic circulation extending upto 9.5 kms a.s.l.)	19	Iran and adjoining Afghanistan	Stationary	*In situ*	Initially, it lay as a trough in mid-tropospheric westerlies with its axis at 5.8 kms a.s.l. extending along Long. 48° E to the north of Lat. 30° N on 17th. The low became less marked on 20th. The associated cyclonic circulation moved away on 23rd
(*ii*)	*As a trough*					
1.	Low tropospheric levels	1-4	Along Long. 87° E to the north of Lat. 28° N (axis at 5.8 kms a.s.l.)	East northeast	Along Long. 90° E to the north of Lat. 25° N (upto 1.5 kms a.s.l.)	It moved away eastwards
2.	Mid and upper tropospheric levels	2-7	Along Long. 54° E to the north of Lat. 32° N (axis at 5.8 kms a.s.l.)	Do	Along Long. 89° E to the north of Lat. 28° N	WD moved away east-northeastwards
3.	Mid and upper tropospheric levels	6-10	Along Long. 52° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	Northeast	Along Long. 72° E to the north of Lat. 30° N	WD moved away east-northeastwards
4.	Mid tropospheric levels	8	Along Long. 58° E to the north of Lat. 28° N (axis at 5.8 kms a.s.l.)	Stationary	*In situ*	Became less marked on 9
5.	Upto 1.5 km a.s.l.	21	Cyclonic circulation over Pakistan and adjoining Jammu & Kashmir to Northwest Madhya Pradesh	Do	Do	Became less marked on 22
6.	Upto 0.9 km a.s.l.	16	West Rajasthan to north Madhya Pradesh	Do	Do	Became less marked on 17

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
7.	Mid and upper tropospheric levels	23-27	Along Long. 65° E to the north of Lat. 37° N (axis at 5.8 kms a.s.l.)	East northeast	Along Long. 78° E to the north of Lat. 30° N	WD moved away east-northeastwards
8.	Do	26 -27	Along Long. 71° E to the north of Lat. 35° N (axis at 5.8 kms a.s.l.)	Do	Eastern parts of Jammu & Kashmir and neighbourhood (as a cyclonic circulation)	It moved away east-northeastwards
9.	Do	27 Mar-4 Apr	Along Long. 62° E to the north of Lat. 30° N (axis at 7.6 kms a.s.l.)	Do	Eastern Arunachal Pradesh to North Bay of Bengal	Became less marked on 5th April
(*iii*)	*As an induced cyclonic circulation*					
1.	Upto 1.5 km a.s.l.	14-15	Punjab and neighbourhood	East	Punjab and adjoining Haryana	Became less marked on 16
2.	Do	18-19	South Pakistan and adjoining southwest Rajasthan	East northeast	South Pakistan and neighbourhood	Became less marked on 20
(C)	*Other upper air cyclonic circulations*					
1.	Upto 1.5 km a.s.l.	2-3	Maldives area & neighbourhood	West	-	Moved away westward
2.	Do	5	Madhya Maharashtra and neighbourhood	Stationary	*In situ*	Became less marked on 6
3.	Upto lower tropospheric levels	5-9	Lay over Commorin area and neighbourhood	West	Maldives Comorin area	Became less marked on 10
4.	At lower levels	5-9	East Bihar and adjoining Sub Himalayan West Bengal	Stationary	*In situ*	Initially it lay as an embedded cyclonic circulation in the N-S trough from sub Himalayan West Bengal & Sikkim to north Chhattisgarh across Jharkhand. The trough became less marked on 6th. The cyclonic circulation became less marked on 10
5.	Do	8-11	Lakshadweep to Konkan	Do	Do	Became less marked on 12
6.	Do	12	North Odisha and neighbourhood	Do	Do	Became less marked on 13
7.	At 1.5 kms a.s.l.	8-11	North Madhya Maharashtra and neighbourhood	Oscillatory	North Madhya Maharashtra and neighbourhood	Merged with the North Madhya Maharashtra to south Madhya Pradesh, N-S trough on 12th
8.	At 0.9 kms a.s.l.	12-14	North Madhya Maharashtra and adjoining Madhya Pradesh	Stationary	*In situ*	Initially it was a trough from Madhya Pradesh to south Madhya Maharashtra across west Vidarbha on 12th at 0.9 km a.s.l. The cyclonic circulation became less marked on 15th
9.	Upto 0.9 kms a.s.l.	16	South Odisha and neighbourhood	Do	Do	Became less marked on 17
10.	Upto 0.9 kms a.s.l.	17	Southeast Rajasthan and adjoining west Madhya Pradesh	Do	Do	Became less marked on 18
11.	Upto 1.5 kms a.s.l.	17	East central Arabian Sea off Karnataka coast	Do	Do	Became less marked on 18
12.	Upto 0.9 kms a.s.l.	19-20	Southeast east Arabian Sea off Kerala coast	Do	Do	Became less marked on 21

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	Upto 1.5 kms a.s.l.	19	North Madhya Maharashtra and neighbourhood	Stationary	*In situ*	Became less marked on 20
14.	Upto 0.9 kms a.s.l.	20-21	Lay over Commorin area and neighbourhood	Do	Do	Became less marked on 22
15.	Do	20	Southeast Rajasthan and adjoining west Madhya Pradesh	Do	Do	Became less marked on 21
16.	Upto 1.5 kms a.s.l.	20	Vidarbha and neighbourhood	Do	Do	Became less marked on 21
17.	Upto 0.9 kms a.s.l.	20	Do	Do	Do	Became less marked on 21
18.	Do	21	North Chhattisgarh and neighbourhood	Do	Do	It merged with the Bihar to interior Tamil Nadu trough on 22
19.	Between 3.1-5.8 kms a.s.l.	22	North Pakistan and adjoining Punjab	Do	Do	It became less marked on 22 evening
20.	Between 1.5-2.1 kms a.s.l.	22-27	Southwest Bay of Bengal off Sri Lanka coast	West	Comorin Maldives area and neighbourhood	It became less marked on 28
21.	Upto 0.9 kms a.s.l.	23-25	Sub Himalayan West Bengal Sikkim and neighbourhood	Stationary	*In situ*	It became less marked on 26
22.	Between 1.5-2.1 kms a.s.l.	23	Haryana and adjoining areas of west Uttar Pradesh and north Rajasthan	Do	Do	It became less marked on 24
23.	Between 0.9-1.5 kms a.s.l.	24	North Konkan and adjoining east central Arabian Sea	Do	Do	It became less marked on 25
24.	Upto 0.9 kms a.s.l.	25-28	Southeast Arabian Sea off Kerala-Karnataka coasts	-	North interior Karnataka and adjoining areas of Telangana and Marathwada	Merged with the north south trough from southeast Uttar Pradesh to south interior Karnataka across east Madhya Pradesh, Vidarbha, Telangana and north interior Karnataka on 29th
(D)	*Trough in easterlies/trough of low*					
1.	At mean sea level	1	Eastern parts of angladesh and neighbourhood	Stationary	*In situ*	Became less marked on 2
2.	Do	8-11	From Lakshadweep area to Konkan (upto 0.9 km a.s.l.)	Do	Do	Became less marked on 12
3.	Do	16-20	Equatorial Indian Ocean and adjoining south Andaman Sea	Do	Equatorial Indian Ocean and adjoining central parts of south Bay of Bengal	Became less marked on 21
4.	At lower levels (Upto 0.9 kms a.s.l.)	18-19	From Comorin area to south Madhya Maharashtra across interior Tamil Nadu and interior Karnataka	East	From the cyclonic circulation over southeast Arabian Sea off Kerala coast to north interior Karnataka	Became less marked on 20
5.	Upto 0.9 kms a.s.l.	19	From cyclonic circulation over North Madhya Maharashtra and neighbourhood to central parts of Rajasthan	Stationary	*In situ*	Became less marked on 20

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.	Upto 1.5 kms a.s.l.	27-29	East Bihar to Manipur across south Assam	-	Northern parts of Bangladesh to Manipur across Assam and Meghalaya	Became less marked on 30
7.	Do	24	South Kerala coast to Rayalaseema	Stationary	*In situ*	Became less marked on 25
(**E**)	*North-South troughs/Wind discontinuity/other troughs*					
1.	Upto 1.5 km a.s.l.	6-7	Cyclonic circulation over Comorin area and neighbourhood to South Chhattisgarh across Karnataka, Telangana and Vidarbha (upto 1.5 km a.s.l.)	West	Lakshadweep area and neighbourhood interior Karnataka	Became less marked on 8
2.	At lower levels (2.1-3.1 km a.s.l.)	10-11	Along Long. 88° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	East	Along Long. 90° E to the north of Lat. 24° N (axis at 5.8 kms a.s.l.)	It moved away eastwards on 12
3.	Upto 0.9 kms a.s.l.	18-19	From Comorin area to south Madhya Maharashtra across interior Tamil Nadu and interior Karnataka	Stationary	*In situ*	Became less marked on 20
4.	Do	20	North Odisha to north interior Karnataka across cyclonic circulation over Vidarbha and neighbourhood	Do	Do	Became less marked on 21
5.	Do	21	Madhya Maharashtra to south interior Karnataka across north interior Karnataka	Do	Do	Became less marked on 22
6.	Do	22-25	From Bihar to interior Tamil Nadu across Southeast Uttar Pradesh, east Madhya Pradesh, Vidarbha, Telangana and Rayalaseema	Oscillatory	From Sub Himalayan West Bengal, Sikkim and neighbourhood to Marathwada across east Jharkhand interior Odisha, south Chhattisgarh and Vidarbha	Became less marked on 26
7.	At 0.9 kms a.s.l.	29	Southeast Uttar Pradesh to south interior Karnataka across east Madhya Pradesh, Vidarbha, Telangana and north interior Karnataka	Stationary	*In situ*	Became less marked on 30
(**F**)	*East-West troughs*					
1.	Upto 0.9 kms a.s.l.	3-4	From Sub Himalayan West Bengal to Manipur	Oscillatory	West Assam and neighbourhood (as a cyclonic circulation)	It became less marked on 5
2.	Upto 1.5 kms a.s.l.	27-29	East Bihar to Manipur across south Assam	Do	Northern parts of Bangladesh to Manipur across Assam and Meghalaya	Became less marked on 30
(**G**) *Trough in westerlies/trough of Low*						
1.	Mid and upper tropospheric levels	4	Uttarakhand to West Rajasthan across UP and Haryana	Stationary	*In situ*	Became less marked on 5

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 0.9 kms a.s.l.	4	South Chhattisgarh to North interior Karnataka across Vidarbha	Stationary	*In situ*	Became less marked on 5
3.	Upto 0.9 kms a.s.l.	19	Across East Bangladesh to interior Odisha with an embedded cyclonic circulation over north Odisha and neighbourhood in the trough	Do	Do	Became less marked on 20
4.	At 0.9 kms a.s.l.	13-14	From east Bihar to Manipur across Bangladesh with an embedded cyclonic circulation over Sub-Himalayan West Bengal and adjoining Bihar & Jharkhand	Do	Do	Trough became less marked on 15, the embedded cyclonic circulation became less marked on 16

rain deprived with central India receiving only 7% of LPA. The presence of an anomalous anticyclone and strong ridge that prevailed over the northern and northwestern parts of India in March caused reduction in rainfall activity over the north, Northwest and Central subdivisions.

In April there was an increase in rainfall activity over all the regions than March except for the peninsular region. Passage of western disturbances with moisture feed from Bay of Bengal, formation of troughs/wind discontinuity in the lower levels and the cyclonic circulations caused precipitation over northern, northwestern and central states with west Uttar Pradesh and Jharkhand subdivisions receiving 193% and 181% of its long period monthly average for April.

The well-marked low pressure area over Southeast Arabian Sea off Karnataka Kerala coast, the north-south troughs/wind discontinuities/cyclonic circulations enhanced rainfall activity over the south peninsula in the month of May. Out of the 10 subdivisions in peninsula region, May rainfall was *large excess* in 4 and *excess* and *normal* in 3 each.

During the season, out of 36 meteorological subdivisions, 3 received *large excess* rainfall (all subdivisions from Peninsula), 7 *excess* rainfall while 10 received *normal* rainfall, 11 sub divisions received *deficient* rainfall and 5 *large deficient* rainfall.

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 amounts of rainfall are given in Table 5.

The prevailing northwesterly winds in the lower troposphere over North India deprived regions other than the peninsula India of moisture, leading to large scarcity in the monthly rainfall. There were 18 sub-divisions with *large deficient* rainfall and only 2 sub-divisions received *normal* precipitation in the three regions combined. Due to the presence of an anomalous anticyclone and strong ridge in the lower troposphere that prevailed over the northwestern parts of India and lack of precipitation thereby there was a rise in normal day temperatures and night temperatures. This led to heat wave conditions over Northwest India in general and west Rajasthan in particular in the last week of March and spread to more areas of northwest and central India.

3.1.2. *Temperature distribution*

(*i*) *Minimum temperatures*

The minimum temperatures remained *above normal, appreciably above normal* on most days and *markedly above normal* on one or two days in the first week of

TABLE 3

Details of the weather systems during April 2018

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.	3.1 kms a.s.l.	8-12	Iran and neighbourhood	East-north eastwards	North Pakistan and neighbourhood	A trough lay aloft with its axis at 5.8 kms a.s.l. during 10-16. The WD moved away east-northeastwards along with the trough aloft
2.	At 3.1 kms a.s.l.	9-10	North Pakistan and neighbourhood	Do	East-northeastward	Moved away east-northeastwards
3.	Do	14-16	Northeast Afghanistan and neighbourhood	Do	Northeast Afghanistan and adjoining Pakistan	It moved away northeastwards
4.	Upto 1.5 kms a.s.l.	14-17	South Pakistan and adjoining southwest Rajasthan	Do	South Haryana & neighbourhood	Became less marked on 18
5.	Upto 3.1 kms a.s.l.	14-19	North Pakistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	It moved away east-northeastwards
6.	Do	18-21	Iran and neighbourhood with a trough aloft in mid & upper tropospheric westerlies with its axis at 5.8 kms a.s.l. running roughly along Long. 55° E to the north of Lat. 28° N	Northeast	Lay over Jammu & Kashmir and neighbourhood at 3.1 kms a.s.l. with a trough aloft in mid & upper tropospheric westerlies with its axis at 5.8 kms a.s.l. running roughly along Long. 73° E to the north of Lat. 32° N	The cyclonic circulation lay as a trough running roughly along Long. 80° E to the north of Lat. 25° N at 3.1 kms a.s.l. on 22nd and moved away northeastwards on 26th
7.	At 3.1 kms a.s.l.	27-29	North Pakistan and neighbourhood with a trough aloft with its axis at 5.8 kms a.s.l. running roughly along Long. 72° E and Lat. 32° N	East	Running roughly along Long. 75° E and Lat. 32° N	Moved away eastwards
(*ii*)	*As a trough*					
1.	Mid & upper tropospheric westerlies with its axis at 7.6 kms a.s.l.	14-17	Roughly along Long. 50° E to the north of Lat. 30° N	East	Roughly along Long. 65° E to the north of Lat. 28° N	Moved away northeastwards
2.	Mid & upper tropospheric westerlies	18-19	Roughly along Long. 90° E to the north of Lat. 22° N	East-northeast	-	It moved away east-northeastwards
3.	Mid-tropospheric westerlies with its axis at 5.8 kms a.s.l.	24-25	Ran roughly along Long. 53° E to the north of Lat. 35° N	East	Along Long. 64° E to the north of Lat. 35° N	Lay as a cyclonic circulation at 3.1 kms a.s.l. over Jammu & Kashmir and neighbourhood on 26th. It moved away east-northeastwards on 27th
(**B**)	*Other upper air cyclonic circulations*					
1.	Upto 1.5 kms a.s.l.	1-3	Northeast Madhya Pradesh and neighbourhood	East	North Chhattisgarh and adjoining Jharkhand	Became less marked on 4
2.	Do	1	East Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 2

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Upto 1.5 kms a.s.l.	1-2	Comorin area and neighbourhood	West	Lakshadweep area and neighbourhood	Became less marked on 3
4.	Between 2.1 & 4.5 kms a.s.l.	2-12	Northern parts of Odisha and neighbourhood	East	Eastern parts of Bangladesh and neighbourhood	Became less marked on 13
5.	Upto 1.5 km a.s.l.	3	Haryana and neighbourhood	Stationary	*In situ*	Merged with the northeast Rajasthan, west Madhya Pradesh, western parts of Vidarbha and Marathwada trough on 4th
6.	Upto 0.9 km a.s.l.	3	Sri Lanka and neighbourhood	Do	Do	Became less marked on 4
7.	Do	4-7	Punjab and adjoining north Pakistan	Oscillatory	Central parts of north Madhya Pradesh and adjoining south Uttar Pradesh	Became less marked on 8
8.	Do	3	Sri Lanka and neighbourhood	Stationary	*In situ*	Became less marked on 4
9.	Upto 1.5 km a.s.l.	5-7	Equatorial Indian Ocean and adjoining south Sri Lanka	West	Maldives area and neighbourhood	Became less marked on 8
10.	Do	5	Northwest Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 6
11.	Do	7	Southwest Bay of Bengal off Sri- Lanka coast	Do	Do	Became less marked on 8
12.	Do	8-14	North Madhya Maharashtra and adjoining Vidarbha & southwest Madhya Pradesh	Oscillatory	Southwest Madhya Pradesh and neighbourhood	Became less marked on 15
13.	At 3.1 kms a.s.l.	8-10	South Gujarat Region and neighbourhood	North	Gujarat region	Merged with the trough from west Madhya Pradesh to north Kerala across west Vidarbha, Marathwada and interior Karnataka on 11th
14.	At 0.9 kms a.s.l.	8-9	South Interior Karnataka and neighbourhood	Stationary	*In situ*	Merged with the Lakshadweep area and coastal Karnataka trough on 9th
15.	Upto 1.5 km a.s.l.	9-10	North Haryana and west Uttar Pradesh	Do	Do	Became less marked on 11
16.	Upto 0.9 km a.s.l.	10-11	East Uttar Pradesh and adjoining Bihar	Do	Do	Became less marked on 12
17.	Do	11-12	Southwest Uttar Pradesh and neighbourhood	Do	Do	Became less marked on 13
18.	At 1.5 kms a.s.l.	13-14	South Madhya Pradesh and neighbourhood	Do	Do	Merged with the SW Madhya Pradesh and neighbourhood cyclonic circulation
19.	Upto 1.5 km a.s.l.	16	West Madhya Pradesh and adjoining southeast Rajasthan	Do	Do	Became less marked on 17
20.	At 0.9 kms a.s.l.	17	North Kerala coast and neighbourhood	Do	Do	Became les marked on 18
21.	At 1.5 kms a.s.l.	16	Interior Karnataka and adjoining Rayalaseema	Do	Do	Became less marked on 17

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
22.	At 0.9 km a.s.l.	18	South Konkan & Goa and neighbourhood	Stationary	*In situ*	Became less marked on 19
23.	Do	18	Jharkhand and adjoining Bihar	Do	Do	Became less marked on 19
24.	Upto 0.9 kms a.s.l.	16-18	Sub-Himalayan West Bengal & Sikkim and neighbourhood	Do	Do	Initially it lay as a trough from north Bihar to Manipur across northern parts of Bangla Desh and Meghalaya and extended upto 0.9 km a.s.l. on 15th. The cyclonic circulation lay embedded in the northeast Uttar Pradesh to Manipur trough on 17th, the trough became less marked on 18th. However, the cyclonic circulation extending upto 0.9 km a.s.l. over Sub-Himalayan West Bengal & Sikkim and neighbourhood persisted on 18. Became less marked on 19
25	At 0.9 kms a.s.l.	19-20	Chhattisgarh and adjoining Odisha	East	Interior parts of Odisha	It became less marked on 21
26.	Upto 1.5 kms a.s.l.	20	Northwest Madhya Pradesh and adjoining east Rajasthan	Stationary	*In situ*	It became less marked on 21
27.	Upto 0.9 kms a.s.l.	20	East Uttar Pradesh and neighbourhood	Do	Do	It became less marked on 21
28.	Upto 1.5 kms a.s.l.	20 Apr-10 May	Sub-Himalayan West Bengal & Sikkim and adjoining west Assam	Oscillatory	West Bengal and neighbourhood and extended upto 0.9 km a.s.l.	With a trough aloft running roughly along Long. 88° E to the north of Lat. 20° E from 4th. The trough aloft ran from east Bihar to northeast Odisha across Gangetic West Bengal at 1.5 kms a.s.l. on 10th. The trough and cyclonic circulation became less marked on 11
29.	Do	21	West Uttar Pradesh and adjoining Haryana	Stationary	*In situ*	It became less marked on 22
30.	Do	23-24	South Chhattisgarh and adjoining Odisha	North	Chhattisgarh and adjoining Odisha	Cyclonic circulation lay embedded in the north - south trough ran from the cyclonic circulation over west Assam and neighbourhood to south Tamil Nadu across Gangetic West Bengal, Odisha, coastal Andhra Pradesh and Rayalaseema It became less marked on 25
31.	At 0.9 kms a.s.l.	24-25	Comorin area and adjoining Tamil Nadu	Stationary	*In situ*	It became less marked on 26
32.	Do	25-29	West Uttar Pradesh & neighbourhood	East	Central parts of Uttar Pradesh and neighbourhood	Merged with the Punjab to southeast Madhya Pradesh trough on 30
33.	Upto 1.5 kms a.s.l.	26	Haryana and adjoining Punjab	Stationary	*In situ*	It became less marked on 27
34.	Do	26	Meghalaya and adjoining east Assam	Do	Do	Merged with the Uttar Pradesh-Assam trough on 27
35.	At 3.1 kms a.s.l.	29	South Assam & neighbourhood	Do	Do	It became less marked on 30

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(C) *North-south trough /wind discontinuity /other troughs*						
1.	Upto 0.9 kms a.s.l.	1-2	From cyclonic circulation over northeast Madhya Pradesh and neighbourhood to Comorin area across west Vidarbha, interior Karnataka and interior Tamil Nadu	Oscillatory	Cyclonic circulation over north Chhattisgarh to south interior Karnataka across Vidarbha, Marathwada and north interior Karnataka	Became less marked on 3
2.	At 0.9 kms a.s.l.	3	From west Madhya Pradesh to north Kerala across west Vidarbha, Marathwada and interior Karnataka	Stationary	*In situ*	Merged with the northeast Rajasthan, west Madhya Pradesh, western parts of Vidarbha and Marathwada trough
3.	Upto 0.9 kms a.s.l.	4-6	From Cyclonic circulation over Punjab and adjoining north Pakistan to north interior Karnataka across northeast Rajasthan, west Madhya Pradesh, western parts of Vidarbha and Marathwada	East	From cyclonic circulation over central parts of north Madhya Pradesh and adjoining south Uttar Pradesh to south Konkan across Madhya Maharashtra	Became less marked on 7
4.	Do	7	North Madhya Maharashtra to Rayalaseema across Marathwada and north interior Karnataka	Stationary	*In situ*	Became less marked on 8
5.	At 3.1 kms a.s.l.	11	From cyclonic circulation over north Madhya Maharashtra and adjoining Vidarbha & southwest Madhya Pradesh to coastal Karnataka	Do	Do	Became less marked on 12
6.	Between 3.1 & 5.8 kms a.s.l.	9	From the cyclonic circulation over North Haryana and west Uttar Pradesh to north Chattisgarh across Madhya Pradesh	Do	Do	Became less marked on 10
7.	At 0.9 kms a.s.l.	10	From north interior Tamil Nadu to north interior Karnataka across south interior Karnataka	Do	Do	Became less marked on 11
8.	At 1.5 kms a.s.l.	12	Northwest Rajasthan to southwest Madhya Pradesh	Do	Do	Became less marked on 13
9.	upto 1.5 kms a.s.l.	12-14	From east Bihar to Gangetic West Bengal	Quasi stationary	From Sikkim to north interior Odisha across east Bihar & Jharkhand	Became less marked on 15
10.	At 1.5 kms a.s.l.	14	From Southwest Madhya Pradesh and neighbourhood to north interior Karnataka across Madhya Maharashtra and Marathwada	Stationary	*In situ*	Merged with the coastal Karnataka to south Konkan trough on 15th
11.	At 0.9 kms a.s.l.	14	From south interior Karnataka to south Kerala	Do	Do	Became less marked on 15
12.	Do	16-22	From north Madhya Maharashtra to south Tamil Nadu across Karnataka	Oscillatory	From north interior Karnataka to Lakshadweep	Lay as a trough from north interior Karnataka to Lakshadweep upto 0.9 km a.s.l. on 22nd, merged with the west Assam to South Tamil Nadu trough on 23rd

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
13.	At 0.9 kms a.s.l.	17	From south Haryana and neighbourhood to east Vidarbha across central parts of Madhya Pradesh	Stationary	*In situ*	Became less marked on 18
14.	Do	18-19	From north Uttar Pradesh to north Telangana across east Madhya Pradesh and east Vidarbha	East	From east Bihar to the cyclonic circulation over Chhattisgarh and adjoining Odisha across Gangetic West Bengal	Became less marked on 20
15.	Upto 1.5 kms a.s.l.	15	From the cyclonic circulation over west Rajasthan and neighbourhood to coastal Karnataka across southwest Madhya Pradesh, Madhya Maharashtra and south Konkan	Stationary	*In situ*	Became less marked on 16
16.	At 0.9 kms a.s.l.	20	From north Pakistan to circy over northwest Madhya Pradesh and adjoining east Rajasthan across southern parts of Punjab and Haryana	Do	Do	Became less marked on 21
17.	Do	21-24	From east Uttar Pradesh to eastern parts of Vidarbha across east Madhya Pradesh	South east	Ran as a northeast-southwest trough from northeast Jharkhand to north interior Karnataka across cyclonic circulation over Chhattisgarh and adjoining Odisha and Telangana	Became less marked on 25
18.	Upto 1.5 kms a.s.l.	24 Apr-2 May	From Telangana to south Tamil Nadu across Rayalaseema & South Interior Karnataka	Oscillatory	From central parts of Madhya Pradesh to Goa across Vidarbha and Marathwada	Became less marked on 3rd May
19.	At 0.9 kms a.s.l.	25-28	From the West Uttar Pradesh cyclonic circulation to South Konkan & Goa across West Madhya Pradesh and Marathwada	Quasi stationary	From southeast Uttar Pradesh cyclonic circulation to coastal Karnataka across west Vidarbha and Madhya Maharashtra	Became less marked on 29
20.	Do	26	From north interior Karnataka to Tamil Nadu across south interior Karnataka	Stationary	*In situ*	It became less marked on 27
(D)	*Trough In Easterlies*					
1.	Upto 1.5 kms a.s.l.	6-9	Comorin area to south interior Karnataka	West	Southeast Arabian Sea to south Madhya Maharashtra across Lakshadweep area and coastal Karnataka	Became less marked on 10
2.	Upto 0.9 kms a.s.l.	11-13	Comorin area to south interior Karnataka across interior Tamil Nadu	Do	Maldives cyclonic circulation to north interior Karnataka across interior Tamil Nadu, Kerala and south interior Karnataka	Became less marked on 14

TABLE 3 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(E)	*East-Weast Trough*					
1.	Upto 1.5 kms a.s.l.	3-8	From west Rajasthan to Jharkhand across the cyclonic circulation over northwest Madhya Pradesh and north Chhattisgarh	East	Northwest Rajasthan to west Assam across south Uttar Pradesh, south Bihar and northern West Bengal	Merged with the north Chhattisgarh-Madhya Pradesh trough on 9
2.	At 0.9 kms a.s.l.	19-21	From east Bihar to south Assam across Sub-Himalayan West Bengal & Sikkim	Quasi-stationary	Ran from Jharkhand to east Assam across the cyclonic circulations over Sub-Himalayan West Bengal & Sikkim and neighbourhood	It became less marked on 22
3.	Upto 1.5 kms a.s.l.	26	From Punjab to east Assam across cyclonic circulation over Haryana and adjoining Punjab, cyclonic circulation over west Uttar Pradesh and neighbourhood, cyclonic circulation over West Bengal & adjoining Bihar and cyclonic circulation over Meghalaya and adjoining east Assam	Stationary	*In situ*	Became less marked on 27
4.	At 1.5 kms a.s.l.	27-28	From the cyclonic circulation over West Bengal & adjoining Bihar to Manipur across Bangla Desh and Meghalaya	Do	Do	Became less marked on 29
5.	Extended upto 1.5 kms a. s. l.	30 Apr-1 May	From cyclonic circulation over east Bihar & adjoining West Bengal-Jharkhand to Manipur across Meghalaya.	Do	Do	Merged with the northwest Rajasthan to Manipur trough on 2nd
(F)	*Trough in westerlies/trough of Low*					
1.	Between 3.1 & 5.8 kms a.s.l.	9-11	Along Long. 86° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	Northeast	Along Long. 88° E to the north of Lat. 22° N (axis at 5.8 kms a.s.l.)	Moved away east-northeastwards
2.	At mean sea level	10-18	Equatorial Indian ocean and southeast Bay of Bengal	West	Equatorial Indian Ocean and southwest Arabian Sea	Moved away westwards
3.	Do	14-19	Equatorial Indian ocean and southeast Bay of Bengal	Do	Equatorial Indian Ocean and adjoining Maldives area	An embedded cyclonic circulation extending upto 3.1 kms a.s.l. on 14th. It became less marked on 19th, trough became unimportant on 20th
4.	Mid & upper tropospheric westerlies with its axis at 7.6 kms a.s.l.	27-28	Roughly along Long. 86° E and north of Lat. 22° N	Northeast	-	Moved away northeastwards

March over northeast, northwest and central divisions and for the rest of the month these temperatures were *above normal* or *appreciably above normal* on a few days in northwest India. Over the peninsula, minimum temperatures were *below normal* to *appreciably below normal* over all the subdivisions throughout the month, this can be attributed to the enhanced rainfall activity there.

TABLE 4

Details of the weather systems during May 2018

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 / severe cyclonic storm*						
1.	Extremely Severe Cyclonic Storm 'MEKUNU'	21-26	Southwest Arabian Sea	North north-west	Oman near Lat. 19° N/ Long. 52.8° E about 250 kms northwest of Salalah	It became less marked on 27. Details are given in the article on Storms & Depressions over the north Indian Ocean- 2018
2.	Cyclonic Storm 'SAGAR'	17-20	Gulf of Aden	West-south-westwards	Lat. 9.8° N/ Long. 42.6° E	Details are given in the article on Storms & Depressions over the north Indian Ocean-2018
(**B**) *Low pressure area/depressions*						
1.	Well marked low pressure area	27-30	Southeast Arabian Sea off Kerala-Karnataka coast	North	Southeast and adjoining east central Arabian Sea off north Kerala-Karnataka coast	The low pressure area formed under the influence of a cyclonic circulation over the same area. The associated cyclonic circulation extended upto 7.6 km a.s.l. The low pressure area became less marked on 30
2.	Deep depression	29-30	Northeast and adjoining east central Bay of Bengal	Northeast	Myanmar	Became less marked on 31
(**C**) *Western disturbances/eastward moving systems*						
(*i*) *Upper air cyclonic circulation*						
1.	Between 3.1 and 5.8 km a.s.l.	4-10	Western parts of Iran and neighbourhood	East	Jammu & Kashmir and neighbourhood	It lay as a trough in mid & upper tropospheric levels with its axis at 5.8 kms a.s.l. on 9. Moved away east-northeastwards
2.	Do	15-18	East Iran and neighbourhood	Do	Jammu & Kashmir and adjoining north Pakistan	It moved away east-north-east wards
3.	At 3.1 kms a.s.l.	19-23	West Afghanistan and neighbourhood	Do	North Pakistan and adjoining Jammu and Kashmir	Initially it lay as a trough in mid-tropospheric westerlies with axis at 5.8 kms a.s.l. It became less marked on 24. The trough aloft with axis at 5.8 km a.s.l. along Long. 74° E and Lat. 34° N moved away north east wards
4.	Between 3.1 & 5.8 kms a.s.l.	25-27	Eastern parts of Afghanistan and neighbourhood	Do	North Pakistan and neighbourhood	Moved away northeastwards
(*ii*) *As a trough*						
1.	Mid & upper tropospheric levels	11-14	Along Long. 55° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	East	Along Long. 74° E to the north of Lat. 34° N (axis at 5.8 kms a.s.l.)	It lay as a cyclonic circulation extending upto 3.1 kms a.s.l. over Jammu and Kashmir and neighbourhood with a trough aloft on 13. Moved away east northeastwards
2.	Do	13-17	Along Long. 60° E to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	Do	Along Long. 88° E to the north of Lat. 34° N (axis at 5.8 kms a.s.l.)	Moved away northeastwards
3.	Do	16-19	Along Long.55° E to the north of Lat. 32° N (axis at 5.8 kms a.s.l.)	Do	Along Long.72° E to the north of Lat. 32° N (axis at 5.8 kms a.s.l.)	It moved away east-northeastwards

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(D)	*Other upper air cyclonic circulations*					
1.	Upto 1.5 kms a.s.l.	1-4	South Haryana and neighbourhood	North	Haryana and neighbourhood	It became less marked on 5
2.	Upto 0.9 kms a.s.l.	1	North interior Odisha neighbourhood	Stationary	*In situ*	It became less marked on 2
3.	Upto 1.5 kms a.s.l.	3-4	Central parts of south Uttar Pradesh and neighbourhood	Do	East Uttar Pradesh and adjoining Bihar	It became less marked on 5
4.	Upto 0.9 kms a.s.l.	3	North Odisha and neighbourhood	Do	*In situ*	It became less marked on 4
5.	Do	3	West Vidarbha and neighbourhood	Do	Do	It became less marked on 4
6.	Upto 1.5 kms a.s.l.	4-8	Comorin area and neighbourhood	West	Over central parts of south Arabian Sea and neighbourhood	It became unimportant on 9
7.	At 1.5 kms a.s.l.	7-8	West Haryana and neighbourhood	Stationary	*In situ*	It became less marked on 9
8.	Upto 0.9 kms a.s.l.	7-9	East Assam and neighbourhood	Do	Do	Became less marked on 10
9.	Between 1.5 & 2.1 kms a.s.l.	7	South Madhya Maharashtra and adjoining north interior Karnataka and Marathwada	Do	Do	It became less marked on 8
10.	At 1.5 kms a.s.l.	8-12	Lakshadweep area neighbourhood	West	South east Arabian Sea and adjoining Lakshadweep	Became unimportant on 13
11.	Between 2.1 & 3.1 kms a.s.l.	8	Tamil Nadu coast	Stationary	*In situ*	Became less marked on 9
12.	Between 4.5 & 5.8 kms a.s.l.	8-9	South Tamil Nadu and neighbourhood	West	North Kerala and neighbourhood	Became less marked on 10
13.	At lower level	8	South Rajasthan and adjoining Gujarat	Stationary	*In situ*	Became less marked on 9
14.	Between 1.5 & 2.1 kms a.s.l.	9-10	Comorin area and neighbourhood	Do	Do	Became less marked on 11
15.	Upto 0.9 kms a.s.l.	11	South Haryana and neighbourhood	Do	Do	Became less marked on 12
16.	Do	14-18	Central Pakistan and adjoining Punjab and northwest Rajasthan neighbourhood	East	Central parts of south Uttar Pradesh and adjoining Madhya Pradesh	It became less marked on 19
17.	At 1.5 kms a.s.l.	14	Uttarakhand and neighbourhood	Stationary	*In situ*	It became less marked on 15
18.	At 3.1 kms a.s.l.	14-16	Southeast Rajasthan and neighbourhood	East	Southeast Rajasthan and adjoining west Madhya Pradesh	It became less marked on 17
19.	Upto 1.5 kms a.s.l.	14	Northern parts of West Bengal and neighbourhood	Stationary	*In situ*	It became less marked on 15
20.	At 1.5 kms a.s.l.	15	Himachal Pradesh and neighbourhood	Do	Do	It became less marked on 16
21.	Upto 1.5 kms a.s.l.	15-17	East Bihar and neighbourhood	Do	Do	Became less marked on 18
22.	Between 1.5 & 3.1 kms a.s.l.	16-17	South Tamil Nadu and adjoining Comorin area	West	Southeast Arabian Sea	It became less marked on 18

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
23.	Upto 1.5 kms a.s.l.	16	East Assam and neighborhood	Stationary	*In situ*	It became less marked on 17
24.	Between 1.5 & 2.1 kms a.s.l.	17	Southwest bay of Bengal and adjoining Sri Lanka coast	Do	Do	It became less marked on 18
25.	At 1.5 kms a.s.l.	18	South Konkan and neighbourhood	Do	Do	It became less marked on 19
26.	Upto 1.5 kms a.s.l.	19-22	North west Madhya Pradesh and neighbourhood	East	North-east Madhya Pradesh and adjoining east Uttar Pradesh	It became less marked on 23
27.	Between 1.5 and 2.1 kms a.s.l	19	North Gujarat region and adjoining Saurashtra and Kutch	Stationary	*In situ*	It became less marked on 20
28.	Do	19-25	West Bihar and neighbourhood	East	Bihar and neighbourhood	It became less marked on 26
29.	At 3.1 kms a.s.l.	19-23	South Assam and neighbourhood	-	Eastern Assam and neighbourhood	It became less marked on 24
30.	Upto 5.8 kms a.s.l.	19-25	South Sri Lanka and neighbourhood	Northwest	South coastal Tamil Nadu and neighbourhood	It merged with the south Tamil Nadu and neighbourhood cyclonic circulation on 26
31.	At 1.5 kms a.s.l.	20-22	North interior Tamil Nadu and neighbourhood	-	North Tamil Nadu and neighbourhood	It became less marked on 23
32.	Do	22	South west Rajasthan and neighbourhood	Stationary	*In situ*	It became less marked on 23
33.	Do	22	South interior Karnataka neighbourhood	Do	Do	It became less marked on 23
34.	Between 5.8 & 7.6 kms a.s.l.	24	Maldives Comorin area	Do	Do	Merged with the south Tamil Nadu and neighbourhood cyclonic circulation on 25
35.	Upto 0.9 kms a.s.l.	25	Northeast Madhya Pradesh and adjoining southeast Uttar Pradesh	Do	Do	It became less marked on 26
36.	At 5.8 kms a.s.l.	25	Andaman Sea and neighbourhood	Do	Do	It became less marked on 26
37.	Upto 1.5 km a.s.l.	27-30	Punjab and neighbourhood	Do	Do	Became less marked on 31
38.	Upto 0.9 km a.s.l.	27	West Madhya Pradesh and adjoining east Rajasthan	Do	Do	Merged with the cyclonic circulation over northwest Madhya Pradesh
39.	Do	27	Northern parts of West Bengal and neighbourhood	Do	Do	Became less marked on 28
40.	Do	25-26	Interior Tamil Nadu and neighbourhood	South	South Tamil Nadu and neighbourhood	Became less marked on 27
41.	Upto 1.5 kms a.s.l.	28-29	Northwest Madhya Pradesh and neighbourhood	East	Central parts of north Madhya Pradesh and adjoining southeast Uttar Pradesh	Became less marked on 30
42.	Do	29-30	Central Pakistan and adjoining west Rajasthan	Do	Do	Became less marked on 31
43.	Upto 0.9 kms a.s.l.	30 May-1 Jun	Sub-Himalayan West Bengal and neighbourhood	Do	Do	Became less marked on 2

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(E)	*East-West trough/shear zone*					
1.	Upto 0.9 kms a.s.l.	11-13	From east Bihar to Nagaland	East-west	From cyclonic circulation over south Haryana and neighbourhood to Nagaland across north Madhya Pradesh, south Bihar, north Gangetic West Bengal and Meghalaya	It became less marked on 14
2.	At 5.8 kms a.s.l.	16-17	Along Lat. 14° N	South	Along Lat. 12° N	It became less marked on 18
3.	Upto 0.9 kms a.s.l.	17-18	From the cyclonic circulation over central parts of south Uttar Pradesh and adjoining Madhya Pradesh to northeast Bay of Bengal across south Bihar, Jharkhand and Gangetic West Bengal	Quasi-stationary	From south Uttar Pradesh and adjoining Madhya Pradesh cyclonic circulation to northeast Bay of Bengal upto Manipur across south Bihar and northern parts of West Bengal	It became less marked on 19
4.	At 0.9 kms a.s.l.	19-21	From cyclonic circulation over Northwest Madhya Pradesh and neighbourhood to east Assam across Jharkhand and central parts of West Bengal	Northwest	From southwest Rajasthan to the cyclonic circulation over northeast Madhya Pradesh and neighbourhood	It became less marked on 22
5.	Between 3.1 & 5.8 km a.s.l.	28-31	Along Lat. 12° N	North	Along Lat. 9° N	Became disorganized on 1st June
(F)	*Other troughs/wind discontinuity*					
1.	Between 3.1 and 7.6 kms a.s.l.	1-2	Along Long. 86° E to the north of Lat. 20° N	East	Along Long. 90° E to the north of Lat. 18° N	It became less marked on 3
2.	Upto 1.5 kms a.s.l.	3-8	From northwest Rajasthan to west Madhya Pradesh across east Rajasthan	Do	Do	A cyclonic circulation was embedded in the trough over east Rajasthan and adjoining west Madhya Pradesh on 5. It remain embedded over north east Rajasthan and adjoining west Madhya Pradesh till 6. It became less marked on 7. The trough became less marked on 9
3.	Upto 0.9 km a.s.l.	1-3	West Vidarbha and neighbourhood to Lakshadweep area across Marathwada	West	South Madhya Maharashtra and north interior Karnataka	It became less marked on 4
4.	Upto 1.5 kms a.s.l.	4	From the cyclonic circulation over central parts of south Arabian Sea to south interior Karnataka across interior Tamil Nadu	Stationary	*In situ*	It became less marked on 5
5.	Do	5-6	From Marathwada to south interior Karnataka across north interior Karnataka	West	East central Arabian Sea off Karnataka coast across north interior Karnataka	It became less marked on 7
6.	Do	4	From north Madhya Maharashtra to south Konkan	Stationary	*In situ*	The north-south wind discontinuity became less marked on 5
7.	At 3.1 kms a.s.l.	5	Along Long. 92° E to the north of Lat. 22° N	Do	Do	It became less marked on 6

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
8.	At 1.5 km a.s.l.	6-8	Along Long. 86° E to the north of Lat. 22° N	Oscillatory	Along Long. 88° E to the north of Lat. 24° N	Merged with the east Bihar to interior Odisha across east Jharkhand trough on 9
9.	Upto 0.9 kms a.s.l.	7-8	From north interior Karnataka to south interior Tamil Nadu across south interior Karnataka	Stationary	*In situ*	It became less marked on 9
10.	Do	9	From north interior Karnataka to south interior Tamil Nadu across south interior Karnataka	Do	Do	Became less marked on 10
11.	Upto 1.5 kms a.s.l.	10-11	From Uttarakhand to south Uttar Pradesh	North south	From northern parts of east Uttar Pradesh to north Chhattisgarh	It became less marked on 12
12.	Upto 0.9 kms a.s.l.	10-11	From north west Rajasthan to south Madhya Maharashtra across west Madhya Pradesh	Stationary	From northwest Rajasthan to north Madhya Maharashtra	Became less marked on 12
13.	At 1.5 kms a.s.l.	10	From the cyclonic circulation over Lakshadweep and adjoining southeast Arabian Sea to north interior Karnataka across coastal Karnataka	Do	*In situ*	It became less marked on 11
14.	Up to 0.9 kms a.s.l.	12-14	From Haryana to northwest Madhya Pradesh across east Rajasthan	North-south	From the cyclonic circulation to north Madhya Maharashtra across southeast Rajasthan and west Madhya Pradesh	It became less marked on 15
15.	At 3.1 kms a.s.l.	13-16	Along Long. 88° E to the north of Lat. 22° N	Do	Along Long. 92° E to the north of Lat. 22° N	It became less marked on 17
16.	Up to 0.9 kms a.s.l.	13-17	From Rayalaseema to south Tamil Nadu	Oscillatory	South interior Karnataka to Kerala	It became less marked on 18
17.	Do	17-18	From north Haryana to Marathwada across the cyclonic circulation over central parts of south Uttar Pradesh and adjoining Madhya Pradesh	East	From Uttarakhand to west Vidarbha with embedded cyclonic circulation over south Uttar Pradesh and adjoining Madhya Pradesh	It became less marked on 19
18.	Upto 1.5 kms a.s.l.	15-16	From central parts of south Uttar Pradesh to south Madhya Maharashtra across Madhya Pradesh and Vidarbha	Oscillatory	East Uttar Pradesh to Vidarbha across east Madhya Pradesh	It became less marked on 17
19.	Between 1.5 & 3.1 kms a.s.l.	18	From east Bihar to eastern parts of Gangetic West Bengal	Stationary	*In situ*	It became less marked on 19
20.	Upto 1.5 kms a.s.l.	19	From southwest Rajasthan to east Vidarbha across east Rajasthan and Madhya Pradesh	Do	Do	A cyclonic circulation over northwest Madhya Pradesh and neighbourhood lay embedded in the trough. It became less marked on 20
21.	Do	22-24	From northeast Madhya Pradesh and adjoining east Uttar Pradesh cyclonic circulation to north interior Karnataka across west Vidarbha and Marathwada	South	North interior Karnataka to south Tamil Nadu	An embedded cyclonic circulation lay over Madhya Maharashtra and neighbourhood. It became less marked on 24. The trough became less marked on 25

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
22.	At 0.9 kms a.s.l.	23-24	From east Rajasthan to Gangetic West Bengal across north Madhya Pradesh and Jharkhand	Stationary	*In situ*	An embedded cyclonic circulation lay over northwest Madhya Pradesh and neighbourhood. It became less marked on 25
23.	Upto 0.9 kms a.s.l.	25	From north east Madhya Pradesh and adjoining southeast Uttar Pradesh cyclonic circulation to Telangana across east Vidarbha	Do	Do	Became less marked on 26
24.	At 1.5 kms a.s.l.	26-27	East Madhya Pradesh to the cyclonic circulation over south Tamil Nadu and neighbourhood across Vidarbha and interior Karnataka	-	East Madhya Pradesh to south Madhya Maharashtra across west Vidarbha	Became less marked on 28
25.	Upto 0.9 kms a.s.l.	28	From the cyclonic circulation over northwest Madhya Pradesh and neighbourhood to east Assam	Stationary	*In situ*	Became less marked on 29
26.	Upto 1.5 kms a.s.l.	28	From the cyclonic circulation over northwest Madhya Pradesh and neighbourhood to Marathwada across west Vidarbha	Do	Do	Became less marked on 29
27.	Upto 0.9 kms a.s.l.	27-29	From cyclonic circulation over central Pakistan and adjoining west Rajasthan to Jharkhand across northern parts of Madhya Pradesh and Chhattisgarh	Do	Do	It became less marked on 30
28.	Between 4.5 & 5.8 kms a.s.l.	30	Along Long. 89° E to the north of Lat. 23° N	East	Along Long. 93° E to the north of Lat. 22° N	It became less marked on 31
29.	At 0.9 kms a.s.l.	27-30	From the northeast Rajasthan and neighbourhood cyclonic circulation to Telangana across Madhya Pradesh and east Vidarbha	Stationary	*In situ*	Became less marked on 31

The month's and the season's lowest minimum temperature over the plains was 7.4 °C, recorded at Agumbe (South Interior Karnataka) on 1st and 3rd March, 2019.

(*ii*) *Maximum temperatures*

Severe Heat wave conditions prevailed on 1 to 2 days over Himachal Pradesh, West Rajasthan and Saurashtra & Kutch.

Heat wave conditions observed on 1 or 2 days over Uttarakhand, Gujarat, west Rajasthan, Himachal Pradesh and north Konkan. These conditions were observed on the 1st day and then in the last week (26-31 March) of the month.

Maximum temperatures were *appreciably above normal* to *markedly above normal* over north and northwest India on most days during the month of March.

Anomalous anticyclonic flow over north and northwest India, dearth of precipitation and negative OLR anomalies aided in the day maximum

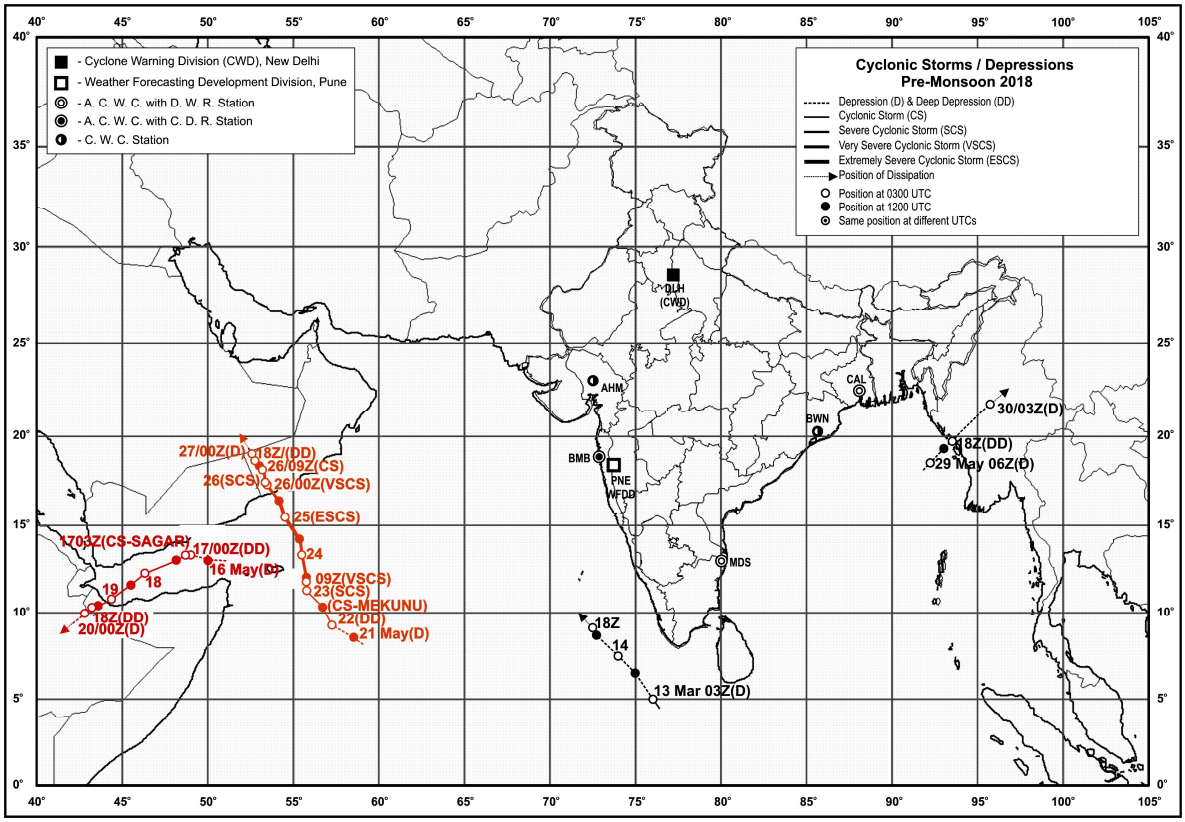

Fig. 2. Track of cyclonic storm during pre-monsoon season 2018

temperatures to remain above normal over northwest India in March.

The month's highest maximum temperature over the plains was 43.4 °C, recorded at Idar (Gujarat) on 29th March, 2018.

3.1.3. *Disastrous weather events and damage*

According to media and other disaster reports, Lightning claimed one life in Tamil Nadu and two in Karnataka. Unseasonal rains and hailstorm damaged Rabi crops in some parts of Rajasthan, the harvested mustard crop lying in the open fields in Neemrana region of Alwar district were also destroyed. Very heavy rain accompanied by gales damaged rice crop in Nellore, Chilli crop in Telangana, lashed Nilgiri trees in Tamil Nadu, uprooted trees and electricity poles in Kochi and blew away rooftops of several houses in parts of Jharkhand. Hailstorm caused extensive damage to standing crops causing huge loss to the farming community in Telangana. Rice crop and mango orchards in Yadadri, Bhuvanagiri, Nalgonda, Jangoan and Siddipet districts got affected by the unseasonal heavy rain.

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.

Western Disturbances and their remnant troughs caused enhanced precipitation over northwest and east India. A brief activation of the near equatorial trough caused an increase in convective activity over the south peninsula. Apart from these, numerous troughs and wind discontinuities owing to the heating of land surface and moisture availability due to the anticyclonic flow in the lower troposphere over Arabian Sea and Bay of Bengal caused thunderstorms and rainfall over the country bringing down the minimum temperatures.

3.2.2. *Temperature distribution*

(*i*) *Minimum temperatures*

The minimum temperatures over most parts of India were *normal* to *below normal* throughout the month

TABLE 5

Some representative amounts of rainfall in cm for the months March, April and May 2018 (5 cm and above)

Date	Some representative amounts of rainfall in cm for March, April and May 2018 (5 cm and above)
1 Mar	Nil
2 Mar	Nil
3 Mar	Rangiya 7, Mangan 6, Golaghat, Kupwara, Goibargaon, Drf, AieNh Xing, Golaghat AWS, Kajolgaon AWS and Tezpur 5 each
4 Mar	Manali 5
5 Mar	Joshimath 5
6 Mar	Tuting 8
7 Mar	Passighat 7, Roing 5
8 Mar	Nil
9 Mar	Nil
10 Mar	Nil
11 Mar	Nil
12 Mar	Nil
13 Mar	Majitar 10
14 Mar	Thoothukudi 20, Papanasam 19, Aryankavu 12, Shencottah 10, Srivaikuntam and Thenkasi 9 each, Tiruchendur 8, Manimutharu U and Ambasamudram 7 each, Ayikudi, Punalur and Nanguneri 6 each, Ottapadiram, Cheranmahadevi and Palayamkottai 5 each
15 Mar	Minicoy 17, Karkala 8, Katra and Amini Divi 6 each, Bantwal, Kota and Rameswaram 5 each
16 Mar	Agathi 11, Roing and Vythiri each 9, B P Ghat and Cherrapunji 7 each, Matijuri, Arkalgud, Chickmagalur, Silchar and Amini Divi 6 each, Thodupuzha, Tinsukia, Daparijo, Koppa, Margherita, Koppal PTO, Hassan, Periyapatna and Bharamsagara 5 each
17 Mar	Veligandla and Lepakshi 13 each, Royachoti and Chintamani PTO 10 each, Chapad and Penagaluru 9 each, Tirupattur, Rajampet and Chilamathur 8 each, Vallur, Gorantla, Duvvur, Omalur, Muddanur, Chinnamandem, Kamalapuram, HaveriAPmc and Kadapa 7 each, Sambepalle, Tiruttani, Yercaud, Thottambedu, Alangayam, Nahar Katia, Darsi, Gudiyatham, Tindivanam and Bengaluru Kial 6 each, Tuting, Hesaraghatta, Chittoor, Punganur, RajuPalem, Margherita, Vazhapadi, Srikalahasti, Mulbagal, Shidlaghatta, Rapur, Vinjamur, Konakanamitla and Badvel 5 each
18 Mar	Thenkasi and Ottapalam 7 each, Tuting and Ayikudi 6 each, Tirupuvanam, Papanasam, Konni and Kovilpatti 5 each
19 Mar	Piravam 7, Mavelikara, Napoklu, Medikeri, Puttur HMS, Ernakulam South, Uthagamandalam and Bhagamandala 5 each
20 Mar	Nil
21 Mar	Nil
22 Mar	Nil
23 Mar	Parumbikulam, AieNh Xing and Tiruppur 5 each
24 Mar	Nil
25 Mar	Nil
26 Mar	Nil
27 Mar	Nil
28 Mar	Nil
29 Mar	Nil
30 Mar	Nil
31 Mar	Anjatti 8, Ambalavayal 6, Udayagiri and Dhubri Cwc 5 each
1 Apr	NH5 Gobindpur and Jagdalpur 5 each
2 Apr	Champua, Jagannath Prasad ARG, Thakurmunda, Chandanpur, Hayathnagar and Remuna ARG 5 each
3 Apr	Hassan and Tadpatri 5 each
4 Apr	Nil
5 Apr	Sukma 6, Dwarhat 5
6 Apr	Cooch Behar 6
7 Apr	Sabroom 10, Pilani 9, Jamankira 7, Kaiserganj 6, Hungund, Keongjhargarh, BhingaHmo and Rajgangpur 5 each

TABLE 5 (*Contd.*)

Date	Some representative amounts of rainfall in cm for March, April and May 2017 (5 cm and above)
8 Apr	Chandanpur and Sarath 9 each, Goalpara cwc, Similiguda AWS and Goalpara 7 each, Utnur, Chaibasa, Vicarabad, Betanati ARG and Sarkaghat 6 each, Krishnanagar, Samakhunta AWS, Gohar, Tusuma, Palakurthi, Mohanpur and Raikia ARG 5 each
9 Apr	Gohar, Pullambadi, Dubwali and Maya Bandar 5 each
10 Apr	Lakhipur 7, Car Nicobar, Panagarh AP, Nagapattnam and B P Ghat 6 each, Jenapur, Anandpur, Shillong, Karimganj, Jamshedpur and Bhadrak AWS 5 each
11 Apr	Mathabhanga, Kurupam and Chandikhol ARG 7 each, Mohana, Aluva Pwd and Jalpaiguri 6 each, Gohar, Beki Mathungari, NH31 Bridge, Sausar and Komarada 5 each
12 Apr	Agra 8, Mettupalayam, Saloni, Agra IAF, Bharatpur Tehsil, Rajapalayam, Nainital, Bijapur and Kanyakumari 6 each, Dholai, Thenkasi, Watrap, Haldwani, Kotkasim, Vadipatti, Gangtok, Berhampore and Rupbas 5 each
13 Apr	Cooch Behar and Coonoor 10 each, Dhubri Cwc, Dhubri and Bolagarh ARG 9 each, Kothagiri and Tikrikilla 8 each, Alipurduar Cwc, Bankura, Champua, Chepan, Mathabhanga and Sivagiri 7 each, Aswapuram, Manjeri, Bankura Cwc and Tyagarthi 6 each, Barobhisha, Koloriang, K Bridge, Passighat, Bangiriposi, Gossaigaon, Chintur, Sakleshpura, Jamsolaghat, Sevoke and Chauldhowaghat 5 each
14 Apr	Vilathikulam 11, Sivaganga 10, Roing and Kochi AP 7 each, Pattukottai, Vaikom, Coonoor and Bodinaickanur 6 each, Nongstoin, Pechiparai, Jayapura, Koppa, Nagercoil, Chauldhowaghat, Gossaigaon and Kamudhi 5 each
15 Apr	Kannur 8, Betanati ARG 7, Nawarangpur, Thakurmunda, Kanyakumari, Chintapalle, Parvathipuram, Digha, Sorada, Chittampatti, Lakhandur, K Bridge, Swam-Patna and Balimundali 5 each
16 Apr	Vaikom and Vythiri 6 each, Parumbikulam, Bidar and Kozha 5 each
17 Apr	Bodinaickanur 10, Myladumparaagri 6, Kozha 5
18 Apr	Bhira 5
19 Apr	Barobhisha 12, Chepan 11, Dholla Bazar 6, Kamalpur and Sabroom 5 each
20 Apr	Kalasa, Mani, Damthang and Balehonnur 6 each
21 Apr	Cherrapunji (Rkm) 9, Amraghat 8, B P Ghat, Sabroom and Karimganj 7 each, Dharmanagar / Panisagar 6, Bihubar, Sivasagar, Shalimar AGRO, Nalbari (Barkhetri AWS), Neamatighat, Cherrapunji, N. Lakhimpur, Williamnagar, Silchar, Koyyalagudem, Annapurnaghat and Lakhipur 5 each
22 Apr	Belonia 11, Amarpur and Tadong 9 each, Ponnani, Gangtok and Agartala AP 8 each, Udaipur and Angadipuram 7 each, Cherrapunji and Tezu 6 each, Kailashahar and B P Ghat 5 each
23 Apr	Gossaigaon and Kamalpur 6 each, Roing and Barobhisha 5 each
24 Apr	Tihidi ARG, Vaikom and Seetharamapuram 5 each
25 Apr	Therlam 10, Prathipadu and Merakamudidam 8 each, Tuni and Anakapalle 6 each, Vaikom, Cheepurupalle, Garividi, G Bazar, Pusapatirega, Anakapalle AP and Mangan 5 each
26 Apr	Periyar 7
27 Apr	Nancowry and Perumpavur 7 each
28 Apr	Deomali 5
29 Apr	Car Nicobar 10, Banki ARG7 , Kakatpur, Chaparmukh and Thoubal AWS 5 each
30 Apr	Sabroom and Malda 8 each, Deogaon Lalganj 7, Ranikhet (G) and Gangtok 6 each
1 May	Krishnaprasad and Mandasa 13 each, Palasa 12, Satyabadi ARG, Gopalpur and Puri 10 each, Pipili, Brahmagiri AWS, Chhatrapur and Gobichettipalayam 9 each, Angadipuram, Basudevpur AWS and Kaptipada ARG 8 each, Sagar, Balikuda ARG, Salem, Belonia, Mannarkad, Goalpara and Banpur 7 each, Khowai, Bargarh, Kamalpur, Perinthalamanna, Balipatna ARG, Remuna ARG, Vadakara and Bhavani 6 each, Nawarangpur, Manmothnagar, Agartala AP, Paradip, Digha, Gossaigaon, Kantapada ARG, Perundurai, Bashirhat, Tinsukia, Balasore, NH5 Gobindpur, Udala, Berhampur, Tangi, Basirhat AWS, Long Islands, Ghatagaon, Barrackpur IAF, Tiruppur, Deganga, Jenapur, Uthagamandalam and Annur 5 each
2 May	Rajmahal 8, Karandighi and Ranastalam 7 each, Visakhapatnam and Kakinada 6 each, Kondagaon, Quilandi, Palakonda, Peddapuram, Bheemunipatnam, Guntur and Podili 5 each
3 May	Sivaganga 13, Visakhapatnam 9, Vizianagaram and Denkada 8 each, Nadaun, Amalapuram, Kurupam and Gudh 7 each, Nayagarh, Port Blair, Ottapalam, Nellimarla, Tangi, Bharatpur Tehsil, Ramgarh Bdo, Parvathipuram and Krishnaprasad 6 each, Gania ARG, Vadakkancherry, Attarra, Agra IAF, Garugubilli, Kangra AP and Sagardighi 5 each
4 May	Kodur 15, Magadi and Kangeyam 14 each, Attur 13, Gangarampur 11, Tirumalla AP 10, Sathyamangalam, Tiruppur, Hanamkonda and Raiganj AWS 9 each, Avinasi, Kollegal, Raiganj and Chintamani 8 each, Kadiri AP, Tanakal, Maddur, Venkatapur, Rayalpadu, Parkal, Vempalle, Nallamada, Pakala, Palakkad and Nuzvid 7 each, Obuladevaracheruvu, Dharapuram, Kadiri, Avanigada, Hayathnagar, Melalathur, Channapatna, Allagadda, Bhopalpatnam, Tirupathi (AGR), Mulug, Tirupathi AP, Mandya, Mundlamuru and Vinjamur 6 each, Kalimpong AWS, Huliyurdurga, Penagaluru, Govindaraopet, Manchal, Ramanagara, R.K.Pet, Kodungallur, Bhuvanagiri, Chittoor, Pollachi, Shayampet, Magadi AGRO, Dindigul, Kalingpong, Darjeeling AWS, Muddanur, Dubbak, ThuvakudiImti, Chanchal, Bhupalpalle, Amadagur, Vijaywada AP, Zaffergadh, Vadakkancherry, Repalle, Khowai, Atmakurwrgl and Thrithala 5 each

TABLE 5 (*Contd.*)

Date	Some representative amounts of rainfall in cm for March, April and May 2017 (5 cm and above)
5 May	Kamalpur 11, Kailashahar, Tikrikilla, Lakhipur and Dharmanagar / Panisagar 7 each, Passighat, Port Blair, Khowai and Silchar 6 each, Tinsukia, Matijuri, Chottabekra, Kadaladi and Kohima 5 each
6 May	Silchar 15, Annapurnaghat 14, Lakhipur 13, Matijuri 10, Chottabekra 9, Konni 8, Mancompu 7, Haflong and Thoubal AWS 6 each, Kurudamannil, Cherthala and Cherrapunji 5 each
7 May	Barpathar 10, Chottabekra 8, Amarpur 7, Agartala AP, Udaipur, Thodupuzha and Sabroom 6 each, Arundhutinagar, Kurudamannil, Khowai, Pechiparai, Belonia, Dholai, Sonamura and Hidkal Dam 5 each
8 May	Kamalpur 10, Kailashahar, Sabroom and Lunglei 8 each, Khowai, Chottabekra and Dharmanagar / Panisagar 7 each, Padalur and Medikeri 6 each, Bahalpur, Goalpara, Goalpara AWS, Kokrajhar, Williamnagar, Arimalam, Quilandi, Nalbari (Barkhetri AWS), Goalparacwc and Gossaigaon 5 each
9 May	AieNh Xing and Dillighat 13 each, Kovilankulam 12, Maniyachi, ManashNh Xing and Margherita 11 each, Chittampatti and Miao 10 each, Melur and Angadipuram 9 each, Cherrapunji (Rkm) 8, Khowang, Thiruvananthapuram, Badatighat, Renuka / Dadhau and Mettupatti 7 each, Mashobra AGRO, Nahar Katia, Valparai, Khliehriat, Perinthalamanna, Shimla, Thrithala, Vaikom, Bihpuria AWS, Lingadahalli, Tirupuvanam, Bhagamandala, ThuvakudiImti and Kalasa 6 each, Mudigere, Balehonnur, Moranhat, Thalavadi, Kozhikode, Forbesganj, Tirumangalam, Chhamonu, Serchip (Hydro), Halli Mysore, Manjeri, Annapurnaghat, Nalbari (Barkhetri AWS), Shekhampore ARG, Kushalnagar, Chittur, Kudulu, Panbari and Kottigehara 5 each
10 May	Kodaikanal 11, Asansol and ValparaiTaluk Office 10 each, Virudunagar AWS 9, Kundapur, Kamalpur, Asansol Cwc and Tiruchirapalli AP 8 each, Trichy town, Virudhunagar, Karkala, Chalakudi, Vadakkancherry, Palawancha, Mangaluru and Palakkad 7 each, Mangalooru AP, Silchar, Mapusa, Samayapuram, Kansabati Dam, Valparai, Margao, Cherrapunji, Cherthala, Madhabarida and Margherita 6 each, Williamnagar, Mangoldoi, Kunnamkulam, Udaipur, Mulki, Kota, Roing, Irinjalakuda, Madurai AP, Chaparmukh, Minicoy and K. Paramathy 5 each
11 May	Dharwad PTO and Williamnagar 7 each, Dudda, Vaikom and Piravam 6 each, Neora, Medikeri, Hassan, Grand Anaicut, Kailashahar, Manamadurai, Canacona, Bengaluru CO, Malbazar ARG, Nelamangala, Nawana, Rajmahal, Hiriyur HMS and Gangtok 5 each
12 May	Sorada 8, Vaikom, Sabroom and Panambur 7 each, Bhagamandala and Visakhapatnam AP 6 each, Barrackpur IAF, Kota, Buxaduar, Kalingapatnam and Tekkali 5 each
13 May	Vaikom, Sivaganga and Hut Bay 8 each, Kozha, Utnur and Manthani 7 each, Krishnaprasad and Thodupuzha 6 each, Piravam, Pechiparai and Dhone 5 each
14 May	Darauli 15, Baheri and Thiruvananthapuram 10 each, Vepada 8, Chodavaram, Salbari, Paralakhemundi, Pathapatnam, Barrackpur IAF, Thrithala and Srungavarapukota 7 each, Midnapore Cwc, Shirali, Chandbali, Thiruvananthapuram AP, Parsa and Kalasa 6 each, Belgaum (Sambra), Chittur, Anakapalle, Canning Town, Gaunaha, Kannur, Darjeeling, Darbhanga, Damthang, Shidlaghatta, Ghazipur, Mentada, Bhore, Panambur, Champasari, Rajgarh and Quilandi 5 each
15 May	Tiruchengode and Jujumura ARG 7 each, Talcher, Manki and Narsipatnam 6 each, Banki ARG, Haveri PTO, Chitradurga, Mudigere, Angul, Alur, Panjim (Goa), HaveriAPMC, Haldibari, Barmul, Tondi, Ramannapeta, Atchampet, Peddemul and Manamelkudi 5 each
16 May	Kamalpur 15, Karandighi 14, Raiganj 9, Gangarampur 8, Mayanur, Dharmanagar / Panisagar, Thuraiyur, Chanchal, Agartala AP and Kaliaganj 7 each, Tapan, Vellanikkara, Balurghat, Kundgol and Ottapalam 6 each, Khowai, Arundhutinagar, Kailashahar, Neora, Purnea, Daparijo, Irinjalakuda, Raiganj AWS and Rohtak 5 each
17 May	Thodupuzha 8, Diamond Harbour, NH5 Gobindpur and Rajghat 7 each, Solapur, Kankadahad ARG, Jaleswar, Jayapura, Thakurmunda, Balipatna ARG, Danagadi ARG, Perungalur, Durgachak and Sattur 5 each
18 May	Agartala AP 24, Khowai 18, Kollam Rly 12, Kuzhithurai 11, Nagercoil 10, Kammardi, Bissem -Cuttack and Neyyattinkara 9 each, Mangalooru AP, Udaipur and Mangaluru 8 each, Arundhutinagar, Udupi, Varkala and Kamalpur 7 each, Kanyakumari, Colachel, Mylaudy, Panambur, Kurudamannil, Dharwad PTO, Nellimarla, Vadakara and Jorhat 6 each, Bhoothapandy, Pechiparai, Thuckalay, Dharmanagar / Panisagar, B Bagewadi, Denkada, Golkonda, Eraniel and Nedumangad 5 each
19 May	Malbazar ARG 12, Car Nicobar IAF 11, Car Nicobar and Sivaganga 9 each, Amarpur, Neora, Udaipur and Gajoldoba 8 each, Champasari and Colachel 7 each, Venbavur, Sonamura, Chandanpur, Manamadurai, Mayanur and Kanyakumari 5 each
20 May	Ponnani, Koppal PTO and Kollur 9 each, Ramnagar 8, Kumta and Udaipur 7 each, HaveriAPmc, Kundapur and Cherrapunji 6 each, Sulya, Dharmanagar / Panisagar, Amarpur, Sonamura, Vellore, Pattambi, Siddapura, Sargur and Samastipur 5 each
21 May	Amarpur 11, Hasimara and Alappuzha 8 each, Phiringia ARG and Serchip (Hydro) 7 each, Khowai, Binika, Agartala AP, Gajoldoba, Bellur, Sabroom and Kamalpur 6 each, Ranchi AP, Champua, Kankadahad ARG, Panposh, Thodupuzha and Belonia 5 each
22 May	Amarapuram 9, Gobichettipalayam 7, Udupi, Alappuzha, Roing, Samayapuram and Honnali 6 each, Madhugiri, Erode, Ilkal, HaveriAPmc, Kangeyam, Hesaraghatta, Kunurpi and Naharlagun 5 each
23 May	Buxaduar 27, Murti 14, Nagarkata 13, Beki Mathungari, NH31 Bridge and Neora 10 each, Bonth and Mahanga ARG 9 each, Kolkata AP and Chengmari/Diana 8 each, Jajpur, Pullambadi, Kalingpong, Akhuapada, Sevoke and Jalpaiguri 7 each, Bagrakote, Harinkhola, Binjharpur ARG, Williamnagar and Kumargram 6 each, Dharmapuri, Digha, Jagtial, Itanagar, Danagadi ARG, Domohani, Kollam Rly, Nischintakoili ARG, Anandpur, Balasore and Falakata 5 each

TABLE 5 (*Contd.*)

Date	Some representative amounts of rainfall in cm for March, April and May 2017 (5 cm and above)
24 May	Forbesganj 30, Murti 21, Jalpaiguri 19, Nagarkata 18, Neora 17, Tezu 16, Domohani, Malbazar ARG and Buxaduar 13 each, Chengmari/Diana 12, Passighat 10, Sivaganga 9, Naharlagun and Balipatna ARG 8 each, Bhubaneshwar AP, Krishnaprasad, Kantapada ARG and Sevoke 7 each, Dharwad PTO and Itanagar 6 each, Halli Mysore, Haliyal, Namsai, Kottigehara, Tirtol ARG, Samayapuram, Hassan, N. Lakhimpur and Bevoor 5 each
25 May	Cherrapunji 25, Cherrapunji (Rkm) 23, Ponnani 16, Dhubri and Dhubri Cwc 14 each, Bhalukpong 12, Cooch Behar and Beky Rly. Bridge 11 each, Nongstoin 9, Barpeta, Kunnamkulam, Barobhisha, Vellanikkara, Tuting, Tiruvaiyaru, Minicoy and Chatrapatti (Odanchatra) 8 each, Thiruchuzhi, Vadakara, AieNh Xing, Chengannur, Kamudhi, Williamnagar, Karaikudi, Passighat, Bhagamandala, Bahalpur, ManashNh Xing, Drf, Mathabhanga, Goibargaon, Gossaigaon and Hazuah 7 each, Chepan, Tamulpur, Thrithala, Pattambi, Tirupuvanam, Haripad, Mangan, Kadaladi, Ottapalam, Mancompu, Peraiyur, Mavelikara, Sivaganga and JiaBharali N T Xing 6 each, Tirukattupalli, Sattur, Nancowry, Sankalan, Kurudamannil, Laikera, Tirupathur, Numaligarh, Rangiya, Sargur, Kokrajhar, Chengam, Melabazar/Matunga, Chamarajanagar AWS, Car Nicobar, Baliguda, Rasipuram, Kodungallur, Arimalam, Jalpaiguri, Melur and Paramathivelur 5 each
26 May	Kumargram 19, ManashNh Xing and AieNh Xing 15 each, Panbari 14, Tamulpur and BekyRly.Bridge 13 each, Sulya and Hazuah 12 each, Majbhat, Devala, Amini Divi and Barpeta 10 each, Drf and Cherrapunji (Rkm) 9 each, Kannur, Buxaduar, JiaBharali N T Xing, Itanagar and G Bazar 8 each, Beki Mathungari, Hut Bay, Cherrapunji, Kollegal, Melabazar/ Matunga, Nelamangala, Perundurai, Thalavadi, Virajpet, Karimganj, Malur and Vadakara 7 each, Puttur HMS, Agathi, Uthagamandalam, Periyapatna, Chepan, Begur, Cooch Behar, Taliparamba, Kanakapura, Mangaluru and Sankalan 6 each, Barobhisha, Sargur, Tiruchengode, Thakurganj, Gundlupet ARG, Gossaigaon, Thalasserry, Mangalapuram, Kollam Rly, Mathabhanga, Pandavaiyar Head, Panambur, Sravanabelagola, Hosur, Rasipuram, Ketti, Varkala, Mani, Magadi and Majitar 5 each
27 May	Panbari 18, Dhubri Cwc and Dhubri 14 each, Cherrapunji (Rkm) 12, Manash Nh Xing 10, Nalbari / Pagladia, Alipurduar Cwc, B P Ghat and BekyRly.Bridge 9 each, Barpeta, Perumpavur and Bihubar 8 each, Karimganj, Periyar, Car Nicobar IAF, Matijuri, Tamulpur, Bhopalpatnam, Sarangapur, Basar and Gossaigaon 7 each, Barobhisha, Aryankavu, AieNh Xing and Nizamabad 6 each, Mangan, Sankalan, Chepan, Goalpara cwc, Nandipet, Rangiya, Tadong, Navipet, Khajuri, Tuting, Hut Bay, Goalpara, Passighat, Kokrajhar and Idukki 5 each
28 May	Amini Divi 26, Kumargram 12, Agathi 11, Goalpara 9, Beky Rly. Bridge, Goalparacwc, Sulya and Gangtok 8 each, Manash Nh Xing, Williamnagar, Hasimara, ValparaiTaluk Office, Somwarpet, AieNh Xing, Panbari, Kota, Subramanya and Konni 7 each, Itanagar, Barpeta, Dhubri Cwc, Udupi, Dharmasthala, Basar and Tadong 6 each, Trichy town, Vaikom, Manjeri, Dhubri, Alipurduar Cwc, Nilambur, Chauldhowaghat, Chengannur, Nedumangad, Bahalpur and Belur 5 each
29 May	Ponnani 16, Peermade To 12, Hut Bay 10, Karkala, Vadakara and Vaikom 9 each, Mulki 8, Periyar, Thodupuzha, Valparai, Arundhutinagar and Vellanikkara 7 each, Angadipuram, Chinnakalar, Amini Divi, Maya Bandar, Papanasam, ThuvakudiImti, Kota, Chottabekra and Ottapalam 6 each, Alipurduar Cwc, Munnar KSEB, Joda ARG, Idukki, Majbhat, Kozha, Port Blair, Kozhikode, Parumbikulam, Falakata, Thrithala, Deoghar, ValparaiTaluk Office, Perinthalamanna, Kurudamannil, Mangaluru, Udupi, Vadakkancherry, Margherita, Laikera, Agathi, Nippani, Aryankavu, Piravam, Nargund, Kamalpur and Sabour 5 each
30 May	Panambur 33, Mangaluru 29, Mangalooru AP 28, Port Blair 23, Puttur HMS and Mudubidre 21 each, Udupi 16, Karkala 13, Kannur, Sulya, Taliparamba and Kudulu 12 each, Madapura 11, Kota, Koppa, Vadakara, Jayapura and Sringeri HMS 9 each, Hosdurg, Medikeri, Subramanya and Nargund 8 each, Bhagamandala, Napoklu and Vaikom 7 each, Irikkur, Quilandi, Mananthavady, Yelburga and Kammardi 6 each, Vellanikkara, Piravam, Long Islands, Virajpet, Thalasserry, Hut Bay, Mani, Ponnani, Gharmura, Chinnakalar, Idukki, Bhadravathi, Somwarpet, Tirumalla AP, Alathur, Manki and Talikote 5 each
31 May	Deobhog 8, Bhupalpalle, Naraini and Kailashahar 6 each, Kuchinda, Lakhanpur ARG, Sinapali ARG, Agartala AP and Santhipuram 5 each

except over North and Northwestern regions where they were above normal to appreciably above normal from 1st to 10th April. These divisions saw significant drop in night temperatures on some days in the last fortnight of the month corresponding with the convective activity.

(*ii*) *Maximum temperatures*

Severe Heat wave conditions prevailed for 2 days over Saurashtra & Kutch.

Heat wave conditions prevailed for 8 days over some parts of west Rajasthan and one day each over Himachal Pradesh, Jammu division, east Rajasthan, Madhya Pradesh and Vidarbha.

The maximum temperatures remained *normal to above normal* over north and northwest on most days and Central India and peninsular India on few days. They were *appreciably* to *markedly above normal* in the first and last week of April over north and northwest subdivisions. Over the north eastern regions the maximum temperatures remained *below normal, appreciably below normal* and *markedly below normal* because of widespread to fairly widespread precipitation, thunder squalls and hailstorms over parts of Northeast India.

The month's highest maximum temperature recorded over the plains was 45.9 °C at Phalodi (west Rajasthan) on 25th April, 2018.

3.2.3. *Disastrous weather events*

According to media and other disaster reports, lightning claimed total of 27 lives during the month of April (2 Madhya Pradesh, 7 Karnataka, 11 Maharashtra, 2 Telangana and 5 from Andhra Pradesh). Three persons died during the last week of April in Maharashtra due to sun stroke. 19 people died in Bharatpur and Dhoplur districts of Rajasthan due to collapse of walls or roof and uprooting of trees during thunderstorm. In Latur district of Maharashtra, 200 hens perished and crops damaged due to heavy rain and 12 sheep killed in Yadgir and Raichur districts in Karnataka. Hailstorm caused extensive damage to orchards, vegetables and crops in Anantnag, Bandipora and Kulgam districts of Jammu & Kashmir. Damage to Soyabean, Gram, Onion, Vegetables including fruits like Mango, Pomegranate crops reported from Hingoli, Latur, Nanded, Osmanabad, Parbhani, Pune districts of Maharashtra. Damage to Wheat and Gram crops reported in Raigarh, Madhya Pradesh.

3.3. *May*

3.3.1. *Weather and associated synoptic features*

(*i*) *Advance of southwest monsoon*

Southwest monsoon reached south Andaman Sea and parts of southeast Bay of Bengal on 25th May, it further advanced relatively faster and set in over Kerala on 29th May (3 days ahead of its normal date). On 30th May the Southwest Monsoon covered some parts of central Arabian Sea, remaining parts of Kerala, most parts of Coastal Karnataka and some parts of South Interior Karnataka and some more parts of interior Tamil Nadu.

(*ii*) *Other synoptic features and rainfall*

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

An extremely severe cyclonic storm 'Mekunu' (21-27 May) and a Cyclonic Storm 'Sagar' (16-20 May) over the Arabian Sea and a deep depression (29-30 May) over the Bay of Bengal formed during the month. All the three systems moved away from the Indian coast.

The first cyclonic storm, 'Sagar' of the season formed over Gulf of Aden, moved away westwards and then moved west-southwestwards crossed Somalia coast on 19th May. The second cyclonic storm intensified into an extremely severe cyclonic storm on 25th and moved northwestwards crossed south Oman coast the same day. The third system of the month was a Deep Depression which crossed Myanmar coast on 29th May leading to fairly widespread to widespread rainfall over east and northeast India in the last week of May.

Apart from these three systems, one well marked low pressure area (27-30 May) also formed over southeast Arabian Sea off Kerala-Karnataka coast during the month. The low pressure area caused widespread to fairly widespread rainfall over Karnataka and Kerala and aided in the rapid advance of monsoon over Kerala and Karnataka.

The development of a well-marked low pressure area over southeast Arabian Sea off Kerala-Karnataka coasts and another Deep Depression on east central Bay of Bengal and neighborhood in the last week of May resulted in strengthening the Cross Equatorial Flow and supported the advance of southwest monsoon.

Western Disturbance, strong moisture laden easterlies in the lower levels over the northern parts of the country and intense heating over plains of northwest India culminated in series of thunderstorms or duststorms with squally/gusty winds at a few places over Jammu Division of Jammu & Kashmir, Punjab, Himachal Pradesh, Uttarakhand with squall/gusty winds over Haryana, Chandigarh & Delhi, Uttar Pradesh, East Rajasthan and Madhya Pradesh on 2nd May. These left a trail of destruction in these states. These conditions prevailed over some days in the month leading to stronger than normal thunder activity making it an exceptionally devastating month.

3.3.2. *Temperature distribution*

The minimum temperatures were *normal* on most days, with *below normal* and *appreciably below normal* on some days over the country.

The first half of the month saw *normal* to *below normal* maximum temperatures over most subdivisions except the northern, northwestern and central subdivisions on a few days. The day temperatures remained *normal* to *markedly above normal* on most days over the above mentioned subdivisions. In the second fortnight of the month in these subdivisions the temperatures were *appreciably above normal* on most days.

Severe heat wave conditions prevailed from 1 to 3 days over west Rajasthan, Vidarbha and Madhya Pradesh. *Heat wave conditions* prevailed on 14 days over Vidarbha, 10 days over west Rajasthan and 8 days over Madhya Pradesh and 1 to 3 days over west Uttar Pradesh, Haryana, Saurashtra & Kutch, Konkan and Goa. The intensity and

spatial extent of the heat waves increased in the last week of the month.

The month's as well as the season's highest maximum temperature of 48.7 °C was recorded at Sri Ganganagar (west Rajasthan) on 29th May, 2018.

3.3.3. *Disastrous weather events and damage*

According to media and other disaster reports, a chain of powerful thunderstorms, pounded parts of north and north-west India killing at least 117 people and leaving a trail of destruction in six states. (Uttar Pradesh, Rajasthan, Uttarakhand, Madhya Pradesh, Punjab and Haryana). Of the 75 deaths in Uttar Pradesh, 46 were reported from the Agra division. Heavy rains that lashed Hyderabad evening uprooted as many as 1250 electric poles. This interrupted power supply to areas serviced by 112 feeders. The rains and gales uprooted trees along major highways which affected vehicular movement, as many as 112 instances of tree falls were reported in Telangana. Due to heavy rainfall followed by a hailstorm, 100 animals were killed in Thanamandi area of Jammu and Kashmir. Heavy rain accompanied by thunder and lightning killed 204 people and several injured in the states of Bihar, West Bengal, Uttarakhand, Delhi, Uttar Pradesh, West Bengal, Jharkhand and Andhra Pradesh in this month. Heavy rain caused the death of 6 and left thousands homeless after flash floods triggered mudslides in Tripura, Agartala. Three persons from Ballari, Sandur and Hospet taluks in Ballari were killed after being struck by lightning while several houses were damaged in Hassan, as heavy rains accompanied by gusty winds lashed parts of Karnataka. As many as 135 buildings were either partially or fully damaged in rain accompanied by gusty winds and lightning in Udupi district.

Appendix

Definitions of the terms given in '*Italics*'

Temperatures

Markedly below normal - –5 °C or less

Appreciably below normal - –3.1 °C to -5 °C

Below normal - –1.6 °C to -3 °C

Normal - -1.5 °C to 1.5 °C

above normal - 1.6 °C to 3 °C

Appreciably above normal - 3.1 °C to 5 °C

Markedly above normal 5 °C or more

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*

Heat Wave : 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.

Rainfall

Very light - 0.1 to 2.4 mm

Light - 2.5 to 15.5 mm

Moderate - 15.6 to 64.4 mm

Heavy - 64.5 to 115.5 mm

Very Heavy - 115.6 to 204.4 mm

Extremely Heavy - ≥204.5 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%