MAUSAM, **69**, 3 (July 2018), 479-508

Weather in India

MONSOON SEASON (JUNE - SEPTEMBER 2017)†

1. Introduction

The rainfall over the country as a whole during the monsoon season (June-September) was 95% of its long period average (LPA). Seasonal rainfall over Northwest India, Central India, south Peninsula and Northeast India were recorded at 90%, 94%, 100% and 96% of respective LPAs. Out of the total 36 meteorological sub-divisions, 25 sub-divisions constituting 65% of the total area of the country received normal seasonal rainfall, 5 sub-divisions received *excess* rainfall (18% of the total area) and 6 subdivisions (17% of the total area) received *deficient* seasonal rainfall. Monthly rainfall over the country realized as a whole was 104% of LPA in June, 102% of LPA in July, 87% of LPA in August and 88% of LPA in September. Southwest monsoon reached parts of southeast Bay of Bengal, south Andaman Sea and Nicobar Islands on 14th May (6 days ahead of its normal date). It advanced over Kerala on 30th May (2 days ahead of the normal schedule) and covered the entire country by 19th July (4 days later than the normal date).

Monsoon withdrawal was delayed and commenced from parts of northwest India on 27th September (with a delay of nearly 3 weeks). It withdrew from some more parts of northwest India on 30th September. By 11th October, the monsoon withdrew from most parts of northwest India except east Uttar Pradesh. During the season, 14 low pressure systems (1 Deep Depression, 2 Depressions, 6 well marked low pressure areas and 5 low pressure areas) formed against an average of 6 Depressions and 8 low pressure areas.

2. Various aspects of southwest Monsoon (SWM) - 2017

2.1. *Onset and Advance*

Fig. 1 shows the isochrones of advance of monsoon over the country. Table 1 shows advancement of southwest monsoon 2017.

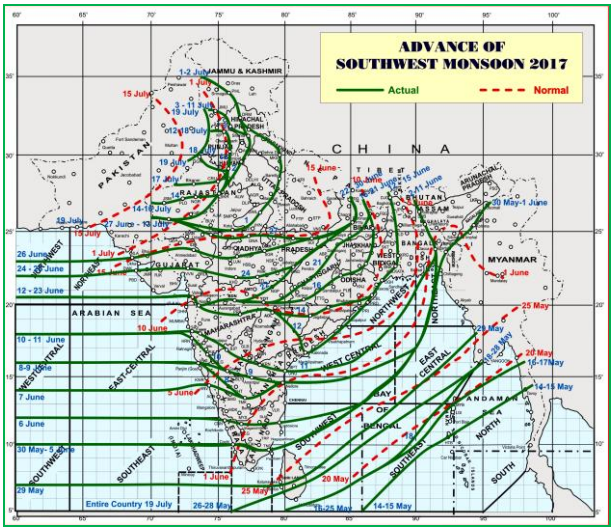

Fig. 1. Isochrones of advance of monsoon 2017

The heating of land mass and moisture availability in the lower troposphere led to convection over major parts of India during the first week of May. Later the Madden Julian Oscillation (MJO) also strengthened and propagated eastwards across the Indian Ocean since 13th May and thus enhanced the convection over the Andaman region. With the formation of a cyclonic circulation over Andaman Sea, southwesterlies crossing the equator strengthened and deepened leading to persistent cloudiness and rainfall over the region. This resulted into advance of Southwest monsoon (SWM) into some parts of southeast Bay of Bengal, Nicobar Islands, entire south Andaman Sea and parts of north Andaman Sea on 14th May. It further advanced into some parts of southwest Bay of Bengal, some more parts of southeast Bay of Bengal and north Andaman Sea and remaining parts of Andaman and Nicobar Islands on 16th May and further into parts of southeast and east central Bay of Bengal and remaining parts of north Andaman Sea on 18th May. However, the predominance of mid-latitude westerlies and sub-tropical ridge during the third week of May caused a hiatus in the further advance of monsoon for 6 days. Towards the end of the month, propagation and strengthening of MJO made conducive conditions for the genesis of Severe Cyclonic Storm (SCS) 'Mora' over the Bay of Bengal during 28th - 31st May. In association with its genesis phase, further advance of SWM took place into southern parts of

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

†*Compiled by* : J. C. Natu, A. P. Kundale, A. S.Shinde, P. N. Chopade, Meteorological Office, Pune – 411 005, India

TABLE 1

Rainfall figures (mm) for each month and season as a whole (June - September 2017) Updated

S. No.	Meteorological Sub-divisions	June			July			August			September			Monsoon		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A & N Islands	349.1	438.6	-20%	389.4	407.7	-4%	414.7	403.8	3%	372.8	432.4	-14%	1526.0	1682.5	-9%
2.	Arunachal Pradesh	370.8	500.4	-26%	437.8	536.1	-18%	456.4	359.9	27%	318.6	371.6	-14%	1583.5	1768.0	-10%
3.	Assam & Meghalaya	485.2	502.3	-3%	429.0	553.9	-23%	483.1	410.3	18%	345.4	326.3	6%	1742.7	1792.8	-3%
4.	Naga, Mani, Mizo and Tri.	502.7	412.1	22%	431.5	415.0	4%	543.3	380.1	43%	352.2	289.7	22%	1829.8	1496.9	22%
5.	S. H. W. B. & Sikkim	400.6	485.2	-17%	478.6	615.8	-22%	777.9	495.2	57%	390.1	410.0	-5%	2047.3	2006.2	2%
6.	Gangetic West Bengal	193.7	244.4	-21%	489.3	331.7	48%	264.5	312.3	-15%	191.4	279.5	-32%	1138.9	1167.9	-2%
7.	Odisha	209.5	214.1	-2%	349.7	337.0	4%	301.7	362.1	-17%	192.2	236.7	-19%	1053.1	1149.9	-8%
8.	Jharkhand	116.0	197.5	-41%	492.1	334.6	47%	246.0	315.8	-22%	134.0	244.0	-45%	988.2	1091.9	-9%
9.	Bihar	84.6	168.5	-50%	379.9	343.5	11%	342.8	291.6	18%	129.6	224.0	-42%	936.8	1027.6	-9%
10.	East Uttar Pradesh	50.8	107.8	-53%	328.9	298.0	10%	185.1	294.5	-37%	85.2	197.3	-57%	650.0	897.6	-28%
11.	West Uttar Pradesh	85.1	71.1	20%	181.0	258.2	-30%	129.8	291.6	-55%	140.7	148.5	-5%	536.5	769.4	-30%
12.	Uttarakhand	175.6	167.8	5%	460.9	428.1	8%	349.0	426.3	-18%	213.4	206.9	3%	1199.0	1229.1	-2%
13.	Haryana, Chandigarh & Delhi	121.2	45.9	164%	69.2	165.8	-58%	76.5	173.6	-56%	92.5	81.0	14%	359.4	466.3	-23%
14.	Punjab	110.8	44.4	149%	94.4	186.0	-49%	122.2	170.4	-28%	62.7	91.1	-31%	390.1	491.9	-21%
15.	Himachal Pradesh	123.1	95.4	29%	216.1	306.9	-30%	273.1	283.0	-3%	103.4	140.0	-26%	715.7	825.3	-13%
16.	Jammu & Kashmir	158.5	64.1	147%	180.7	192.4	-6%	161.4	186.0	-13%	43.3	92.1	-53%	543.9	534.6	2%
17.	West Rajasthan	81.9	29.9	174%	219.7	102.7	114%	43.1	89.3	-52%	21.2	41.3	-49%	365.9	263.2	39%
18.	East Rajasthan	89.9	62.5	44%	293.3	225.2	30%	137.3	228.4	-40%	46.4	99.7	-54%	566.9	615.8	-8%
19.	West Madhya Pradesh	120.0	105.4	14%	292.8	291.6	0%	173.7	308.7	-44%	151.4	170.4	-11%	738.0	876.1	-16%
20.	East Madhya Pradesh	119.0	133.7	-11%	353.8	347.8	2%	179.1	369.7	-52%	144.0	200.0	-28%	795.8	1051.2	-24%
21.	Gujarat Region	137.7	130.8	5%	613.1	341.2	80%	179.7	282.7	-36%	67.2	160.0	-58%	997.7	914.7	9%
22.	Saurashtra & Kutch	81.8	86.9	-6%	368.6	188.5	96%	153.5	126.1	22%	41.8	76.0	-45%	645.8	477.5	35%
23.	Konkan & Goa	840.4	698.1	20%	1095.3	1111.0	-1%	731.2	760.2	-4%	546.9	345.4	58%	3213.8	2914.7	10%
24.	Madhya Maharashtra	189.2	145.6	30%	280.9	242.2	16%	192.0	189.1	2%	190.1	152.4	25%	852.3	729.3	17%
25.	Marathwada	182.3	143.3	27%	82.5	187.2	-56%	230.4	188.2	22%	146.9	164.2	-11%	642.1	682.9	-6%
26.	Vidarbha	147.8	168.0	-12%	252.2	311.9	-19%	198.3	305.7	-35%	133.3	169.0	-21%	731.5	954.6	-23%
27.	Chattisgarh	184.8	185.5	0%	378.3	377.5	0%	300.4	374.8	-20%	177.7	215.5	-18%	1041.2	1153.3	-10%
28.	Coastal Andhra Pradesh	149.6	103.9	44%	153.2	160.4	-4%	224.2	157.7	42%	141.8	159.1	-11%	668.8	581.1	15%
29.	Telangana	202.2	135.9	49%	143.2	238.2	-40%	204.2	218.8	-7%	115.3	162.3	-29%	664.9	755.2	-12%
30.	Rayalaseema	88.9	67.7	31%	52.2	94.2	-45%	171.6	103.3	66%	194.6	133.1	46%	507.2	398.3	27%
31.	Tamil Nadu & Puducherry	47.9	46.0	4%	42.0	68.0	-38%	159.4	87.4	82%	165.3	115.8	43%	414.6	317.2	31%
32.	Coastal Karnataka	831.4	867.7	-4%	820.1	1159.7	-29%	625.2	755.5	-17%	316.5	300.9	5%	2593.2	3083.8	-16%
33.	North Interior Karnataka	131.3	104.6	26%	76.8	135.0	-43%	105.8	120.4	-12%	206.6	146.0	42%	520.5	506.0	3%
34.	South interior Karnataka	107.6	141.5	-24%	125.9	216.1	-42%	181.4	161.4	12%	250.3	141.0	78%	665.2	660.0	1%
35.	Kerala	579.8	649.8	-11%	378.5	726.1	-48%	462.6	419.5	10%	435.5	244.2	78%	1856.5	2039.6	-9%
36.	Lakshadweep	521.9	330.2	58%	164.2	287.7	-43%	206.2	217.5	-5%	216.0	163.1	32%	1108.3	998.5	11%

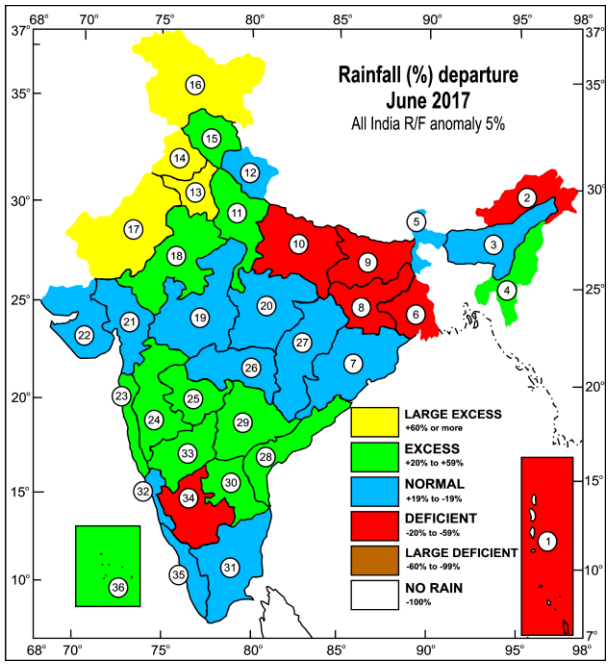

Fig. 2. Rainfall for the month of June 2017 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	-20	**7**	-2	**13**	164	**19**	14	**25**	27	**31**	4
2	-26	**8**	-41	**14**	149	**20**	-11	**26**	-12	**32**	-4
3	-3	**9**	-50	**15**	29	**21**	5	**27**	0	**33**	26
4	22	**10**	-53	**16**	147	**22**	-6	**28**	44	**34**	-24
5	-17	**11**	20	**17**	174	**23**	20	**29**	49	**35**	-11
6	-21	**12**	5	**18**	44	**24**	30	**30**	31	**36**	58

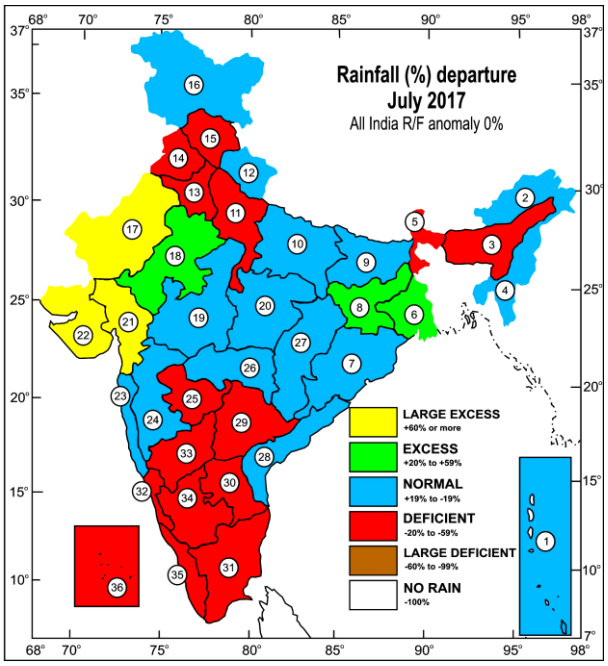

Fig. 3. Rainfall for the month of July 2017 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	-4	**7**	4	**13**	-58	**19**	0	**25**	-56	**31**	-38
2	-18	**8**	47	**14**	-49	**20**	2	**26**	-19	**32**	-29
3	-23	**9**	11	**15**	-30	**21**	80	**27**	0	**33**	-43
4	4	**10**	10	**16**	-6	**22**	96	**28**	-4	**34**	-42
5	-22	**11**	-30	**17**	114	**23**	-1	**29**	-40	**35**	-48
6	48	**12**	8	**18**	30	**24**	16	**30**	-45	**36**	-43

Comorin area and some more parts of southwest, southeast and east central Bay of Bengal on 26th and into some parts of south Arabian Sea, Maldives, Comorin area and some more parts of southwest, southeast and east central Bay of Bengal on 29th May. The SWM set in over Kerala on 30th May. It further advanced into some more parts of northeast Bay of Bengal, remaining parts of Arunachal Pradesh, Nagaland, Manipur, Mizoram and most parts of Tripura and Assam & Meghalaya on 2nd June. Subsequently there was a hiatus in the advancement due to the weakening of the monsoon flow over the Arabian Sea upto 5th June. Later on, the formation of a cyclonic circulation over Madhya Maharashtra and neighbourhood and the formation of a low pressure area over west central Arabian Sea on 6th June revitalized the monsoon current. It led to advance of monsoon over remaining parts of south Arabian Sea, Lakshadweep area, most parts of Kerala and some more parts of Tamil Nadu and southwest Bay of Bengal on 6th and into some parts of central Arabian Sea, remaining parts of Kerala and Tamil Nadu, most parts of coastal Karnataka and south interior Karnataka, some parts of Rayalaseema, coastal Andhra Pradesh and some more parts of central Bay of Bengal on 7th June. The formation of first intense low pressure system as a Deep Depression over North Bay of Bengal and its northward movement during 11-12 June accelerated the monsoon westerlies. This led to advancement of monsoon which almost covered most parts of Peninsular India and entire northeast India by 14th June. It slowed thereafter owing to the presence of anti-cyclones over the Arabian Sea & Bay of Bengal. The presence of a short-lived low pressure area over northwest Bay of Bengal and its associated cyclonic circulation along with the north-south trough over the eastern parts of India and the east-west shear zone along Lat. 17° N & Lat. 18° N led to the advance of monsoon into some more

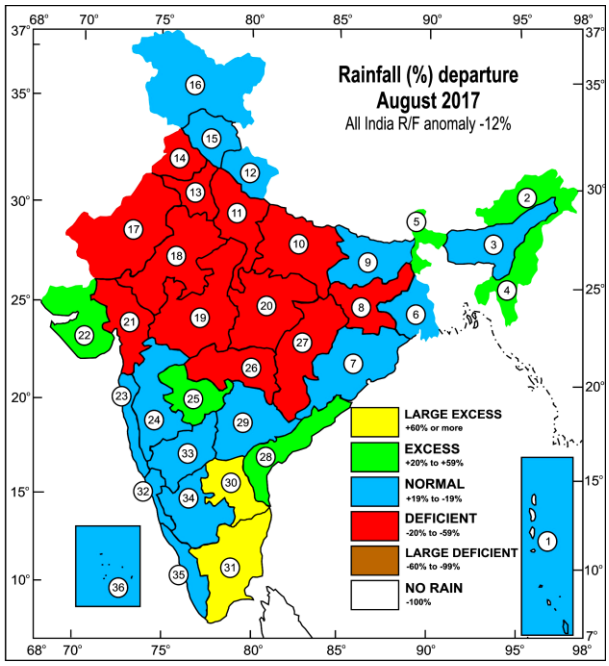

Fig. 4. Rainfall for the month of August 2017 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	3	**7**	-17	**13**	-56	**19**	-44	**25**	22	**31**	82
2	27	**8**	-22	**14**	-28	**20**	-52	**26**	-35	**32**	-17
3	18	**9**	18	**15**	-3	**21**	-36	**27**	-20	**33**	-12
4	43	**10**	-37	**16**	-13	**22**	22	**28**	42	**34**	12
5	57	**11**	-55	**17**	-52	**23**	-4	**29**	-7	**35**	10
6	-15	**12**	-18	**18**	-40	**24**	2	**30**	66	**36**	-5

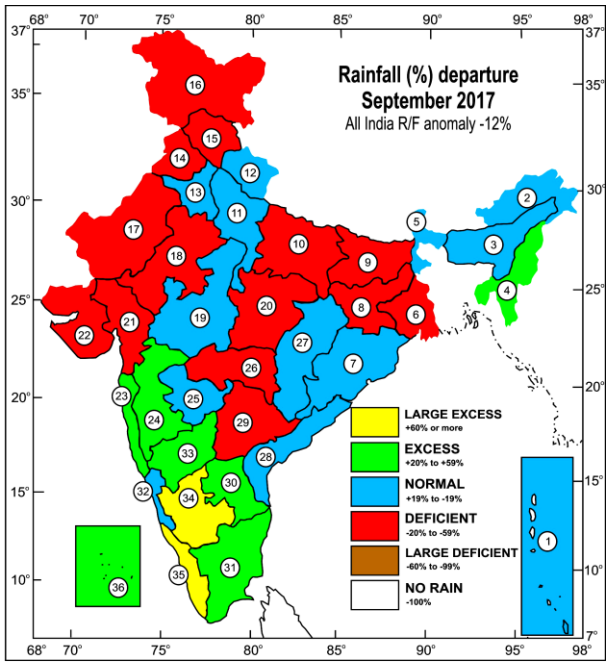

Fig. 5. Rainfall for the month of September 2017 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	-14	**7**	-19	**13**	14	**19**	-11	**25**	-11	**31**	43
2	-14	**8**	-45	**14**	-31	**20**	-28	**26**	-21	**32**	5
3	6	**9**	-42	**15**	-26	**21**	-58	**27**	-18	**33**	42
4	22	**10**	-57	**16**	-53	**22**	-45	**28**	-11	**34**	78
5	-5	**11**	-5	**17**	-49	**23**	-58	**29**	-29	**35**	78
6	-32	**12**	3	**18**	-54	**24**	25	**30**	46	**36**	32

parts of Madhya Maharashtra, remaining parts of Marathwada, some parts of Vidarbha, some more parts of Chhattisgarh, most parts of Odisha, remaining parts of West Bengal and some parts of Jharkhand and Bihar on 16th June and into some more parts of Vidarbha, Chhattisgarh, Jharkhand & Bihar and remaining parts of Odisha on 21st June. During the third week of June, the stronger than normal cross equatorial flow over the Bay of Bengal, increase in north-south pressure gradient and establishment of Tibetan High in its normal position, led to the increased rainfall over the core monsoon zone. This led to further advance of SWM over most parts of central and western India by 27th June. It covered remaining parts of north Arabian Sea, Saurashtra & Kutch, Gujarat region, some more parts of Madhya Pradesh and some parts of south Rajasthan by 27th June. Thereafter, a hiatus of 3 days occurred towards the end of June. Subsequent westward movement of cyclonic circulations along the seasonal trough zone triggered the rainfall activity over the central and north India. It caused further advancement of southwest monsoon over remaining parts of central India and most parts of north India during 1-3 July. It covered remaining parts of Bihar, Madhya Pradesh, Uttar Pradesh and Uttarakhand by 3rd July. Thereafter, the seasonal trough along the northern plains gradually shifted northwards, due to a Western Disturbance which caused widespread precipitation over parts of northwest India. This led to a weak monsoon pattern, with an anomalous anticyclone prevailing over western India causing a prolonged hiatus of 8 days. As the trough became active and a well-marked low pressure area formed over Indo-Gangetic plains, SWM advanced into remaining parts of Himachal Pradesh and Jammu & Kashmir and some more parts of east Rajasthan, Haryana and some parts of Punjab

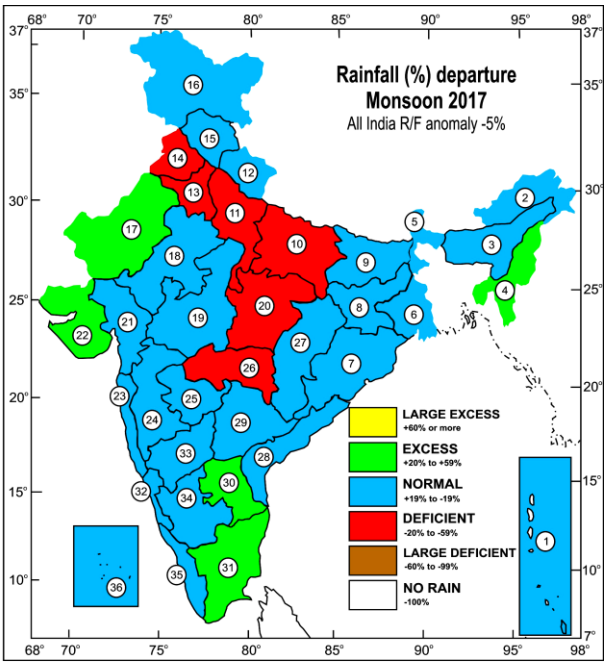

Fig. 6. Rainfall for the month of monsoon 2017 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	-9	**7**	-8	**13**	-23	**19**	-16	**25**	-6	**31**	31
2	-10	**8**	-9	**14**	-21	**20**	-24	**26**	-23	**32**	-16
3	-3	**9**	-9	**15**	-13	**21**	9	**27**	-10	**33**	3
4	22	**10**	-28	**16**	2	**22**	35	**28**	15	**34**	1
5	2	**11**	-30	**17**	39	**23**	10	**29**	-12	**35**	-9
6	-2	**12**	-2	**18**	-8	**24**	17	**30**	27	**36**	11

on 12th July. Further, with the subsequent advance on 14th, 17th and 18th, it advanced into remaining parts of west Rajasthan, Haryana and Punjab on 19th and thus covered the entire country on 19th July, 2017.

2.2. *Monthly rainfall distribution*

Figs. (2-5) show the month wise spatial distribution of rainfall.

In June, 4 subdivisions received *large excess*, 12 sub-divisions received *excess* rainfall, 13 subdivisions received normal rainfall and 7 subdivisions received *deficient* rainfall. The *large excess* regions are Punjab, Jammu & Kashmir and west Rajasthan. Out of the 12 *excess* subdivisions, 3 were from north and northwestern part of the country, 5 were from South Peninsula, 3 from

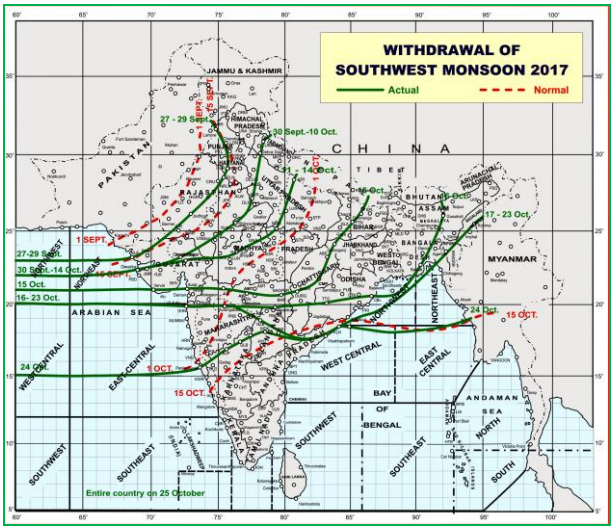

Fig. 7. Isochrones of withdrawal of monsoon 2017

Central India and 1 Nagaland-Manipur-Mijoram and Tripura (NMMT) from Northeast India. Out of 7 *deficient* subdivisions, 4 were from East & Northeast (Bihar, Jharkhand, Gangetic West Bengal and Arunachal Pradesh), 2 from South Peninsula (South Interior Karnataka and Andaman & Nicobar Islands) and one from Northwest (West Uttar Pradesh). Region-wise, Northwest India received *excess* rainfall (+53% of LPA).

In July, 3 subdivisions received *large excess* rainfall and 3 received excess, 15 subdivisions received normal rainfall and 15 subdivisions received *deficient* rainfall. The *large excess* regions were west Rajasthan, Gujarat region and Saurashtra and Kutch. Out of the 3 *excess* subdivisions, 1 was from Northwest India (east Rajasthan) and 2 were from East & Northeast (Jharkhand, Gangetic West Bengal). Out of 15 *deficient* subdivisions majority of the subdivisions (8) were from South Peninsula resulting overall large rainfall deficiency (-36% of LPA) over the region. Out of the remaining 7 *deficient* subdivisions, 4 subdivisions were from northern part of the country (Himachal Pradesh, West Uttar Pradesh, Punjab and Haryana, Chandigarh & Delhi), 2 subdivisions (sub Himalayan West Bengal & Sikkim and Assam & Meghalaya) were from East and Northeas and 1 subdivision Marathwara were from central India.

In August, 6 subdivisions were *excess* and 2 *large excess*, 12 were *deficient* and 16 were *normal*. Most noticeable feature of rainfall distribution during August was that, 6 of the 9 subdivisions from Northwest India and 5 of the 10 subdivisions from Central India were *deficient* resulting in large rainfall deficiencies in both the geographical regions (-33% of LPA in Northwest India and -24% of LPA in Central India). On the other hand,

TABLE 3

Representative amounts of very heavy & extremely heavy rainfall during June-Sept. 2017

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
1 Jun	Valpoi 22, Pernem 16, Mapusa 15, Panjim (Goa) 14, Vengurla and Agartala AP 13 each, Ponda 12
2 Jun	Nagarkata 19, Chengmari / Diana 14, Sabroom and Neora 13 each
3 Jun	Cherrapunji 41, Mawsynram 37, Cherrapunji (Rkm) 24, Roing 15, Panbari and Dhemaji AWS 13 each, N. Lakhimpur, Chauldhowaghat and Agathi 12 each
4 Jun	Kailashahar 23, Dharmanagar / Panisagar 12
5 Jun	Garubathan 14
6 Jun	Port Blair 21, Papanasam 14, Kumta and Garubathan 13 each
7 Jun	Hut Bay and Bevoor 13 each, Deogaon Lalganj 12
8 Jun	Manawar 13, Bagli, Dharangaon and Pernem 12 each
9 Jun	Nil
10 Jun	Harnai 32, Palghar agri and Dapoli agri 21 each, Guhagarh 19, Silvassa 16, Honavar 15, Shirali 14, Ratnagiri, Vagra, Surat and Valsad 13 each
11 Jun	Shirali 27, Agumbe 23, Kundapur 19, Vadakara and Hosanagara 18 each, Siddapura, Kollur and Kota 16 each, Mangaluru AP, Kumta, Luxettipet and Mandangad 15 each, Harnai, Honavar, Mudubidre, Boath, Jalgaon and Panambur 14 each, Karkala and Gersoppa 13 each, Sawantwadi and Tala 12 each
12 Jun	Hosanagara 19, Kollur 17, Kumta 16, Mhasla, Gersoppa, Shirali PTO, Mulki and Mudubidre 15 each, Harnai and Honavar 14 each, Agumbe 13, Kudulu and Kota 12 each
13 Jun	Cherrapunji (Rkm) 33, Cherrapunji 32, Serchip (Hydro) 24, Mawsynram 19, Aizawal 18, Bhira 15, Chiplun 14, Bidar and Uran 13 each, Harnai and Wakwali agri 12 each
14 Jun	Kumargram 17
15 Jun	Sivaganga 14, Dimapur AWS 13, Alipurduar Cwc 12
16 Jun	Jukkal and Madnur 12 each
17 Jun	Cherrapunji 64, Mawsynram 61, Cherrapunji (Rkm) 48, Goalpara 19, Goalpara cwc 18, Shillong 14, Shella and Barpeta 13 each
18 Jun	Mangan 16, Annapurnaghat and B P Ghat 13 each
19 Jun	Kondurg 18, Atchampet 15, Burgampadu 14, Khowai and Narla ARG 13 each, Gangarampur and Mulakalapalle 12 each
20 Jun	Mathabhanga and Bankura 18 each, Nagarkata 16, Bankura Cwc and Debagram 15 each, Cooch Behar, Amta, Diamond Harbour, Murti and Digha 14 each, Bashirhat 13
21 Jun	Naktideul 18, Reamal 13
22 Jun	Mawsynram 27, Kumargram and Cherrapunji 25 each, Cherrapunji (Rkm) 18, Alipurduar Cwc and Chepan 16 each, Cooch Behar, Mathabhanga and Barobhisha 14 each, Jhorigam ARG and Gossaigaon 13 each, Alipurduar 12
23 Jun	Nil
24 Jun	Umerpada 29, Ponnani 16, Valia 13, Dholai and Silchar 12 each
25 Jun	Vapi 48, Talasari; 47, Silvassa 38, Daman and Wada 37 each, Madhbun 33, Vikramgad 32, Igatpuri 22, Bhiwandi 21, Thane, Kollur, Jawhar and Valsad 20 each, Shahapur, Belapur (Thane) and Mokheda - FMO 19 each, Karjat agri and Ozharkheda - FMO 18 each, Palghar agri, Ulhasnagar and Pardi 17 each, Ambernath 16, Murbad, Umergam, Kalyan, Lonavala agri, Trimbakshwar, Waghai, Velhe and Mana AP 15 each, Matheran 14, Kaprada, Kundapur, Agumbe, Nanipalson, Kota and Dahanu 13 each
26 Jun	Murud 21, Dehra Dun 18, Kollur, Mani, Mussoorie, Karkala, Bhira and Vadakkancherry 15 each, Tala, Roha and Ukhimath 14 each, Harnai, Vellanikkara, Alibag, Mudubidre, Chiplun and Panhala 13 each, Mahabaleshwar, Sudhagad Pali, Kalasa, Tuting, Puttur HMS, Thane, Sringeri HMS and Bhagamandala 12 each
27 Jun	Pen 21, Lonavala agri 18, Harnai and Mahabaleshwar 17 each, Panhala and Khed 14 each, Dapoli agri 13, Alathur, Chiplun, Roha and Perinthalamanna 12 each
28 Jun	Matheran 19, Roha 16, Vythiri 15, Karnal and Deoband 14 each, Ulhasnagar and Panvel agri 13 each, Bagrakote, Ramtek, Thane and Uran 12 each

TABLE 3 (*Contd.*)

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
29 Jun	Pen 40, Karjat agri 24, Roha and Matheran 23 each, Alibag 20, Khalapur 19, Sudhagad Pali, Tala and Harnai 18 each, Jollygrant and Murud 17 each, Dodamarg, Aligarh, Bhira and Jajpur 15 each, Kalyan, Roorkee and Khed 13 each, Garubathan, Panvel agri, Chhansa, Pushparajgarh, Danta, Sawantwadi and Kankavli 12 each
30 Jun	Bhira 24, Lonavala agri 19, Rapar and Mahabaleshwar 18 each, Matheran 17, Pen and Ambikapur 16 each, Nasirabad, Katra and Sudhagad Pali 15 each, Champasari, Igatpuri and Kumargram each, Haldibari, Mandangad, Alipurduar Cwc and Shahapur 13 each, Paonta, Madhbun, Tala, Itanagar, Chepan and Porbandar AP 12 each
1 Jul	Mawsynram 29, Itanagar and Cherrapunji (Rkm) 21 each, Chauldhowaghat 20, Cherrapunji 19, Williamnagar 17, Gaunaha 15, Passighat and Ramnagar 14 each, Kosli, Tuting, Naharlagun and Sapaul 12 each
2 Jul	Jawhar 41, Mawsynram 36, Kodinar 35, Siddhpur 33, Tankara 28, Kollur 25, Dantiwada 22, Mokheda FMO 20, Ulhasnagar and Radhanpur 18 each, Bhagalpur and Wankaner 17 each, Palanpur, Budaun, Morbi, Harij, Dhrangadhra, Satlasana and Talasari 15 each, Sutrapada, Halvad, Trimbakeshwar, Diu, Sukma, Ambernath, Sami and Una 14 each, Cherrapunji, Champua, Gersoppa and Silvassa 13 each, Matheran, Jia Bharali N T Xing, Kaprada, Garubathan, Thane, Moradabad Cwc, Vadakara, Tuting, Cherrapunji (Rkm) and Dahanu 12 each
3 Jul	Mawsynram 22, Kollur 16, Cherrapunji and Haldwani 14 each, Waghai and Kalyan 13 each, Gersoppa and Cherrapunji (Rkm) 12 each
4 Jul	Mawsynram 33, Cherrapunji 18, Williamnagar 16, Beki Mathungari and Kollur 15 each, Nalbari / Pagladia 14, Cherrapunji (Rkm), Honavar and Bansgaon 13 each, Dinhata, Melabazar / Matunga and Kumargram 12 each
5 Jul	Banbasa and Kapkot 17 each, Mehmudabad 15, Jia Bharali N T Xing 14, Jainagar, Beberu, Daparijo, Mau Tehsil, Mawsynram and Bindki 13 each, Kollur, Karwi, Pawayan and Chilaghat 12 each
6 Jul	Sardanagar 16, Garubathan 14, Nighasan 13, Guwahati AP, Barpeta and Sambhal 12 each
7 Jul	Karhal 19, Baheri and Haldwani 15 each, Jia Bharali N T Xing 14, Nainital 13, Phoolbagh 12
8 Jul	Chottabekra and Tigiria ARG 12 each
9 Jul	Kumargram and Buxaduar 23 each, Hasimara 22, Itanagar 20, Salbari 19, Chauldhowaghat 18, Alipurduar Cwc and Nagarkata 15 each, Mawsynram, Kunda, Chengmari / Diana and Jalpaiguri 14 each, Chepan, Naharlagun, Baghdogra AP, N. Lakhimpur, Jorhat and Taibpur 13 each, Dhemaji AWS, Alipurduar, Gajoldoba, Thakurganj, Mohitnagar, Murti, Naktideul and Badatighat 12 each
10 Jul	Parsa 27, Balisankara ARG 26, Taibpur 23, Hathwa 20, Nighasan, Thakurganj, Baghdogra AP and Garubathan 19 each, Mahua, Rewaghat, Sevoke and Bagrakote 18 each, Belsand 17, Gajoldoba, Gorakhpur, Churk, Mussoorie and Cooch Behar 16 each, Maharajganj, Mawsynram, Kumargram, Jhanjharpur, Vaishali and Hata 15 each, N. Lakhimpur, Dumka, Haldibari and Buxar 14 each, Fatehpur Tehsil, Birdghat and Kapkot 13 each, Cherrapunji (Rkm), Sundernagar, Darbhanga, Salbari, Hirakud, Dhengraghat and Roing 12 each
11 Jul	Hayaghat 25, Darbhanga 20, Kunda 19. Maheshi 18, Allahabad Sadar and Galgalia 17 each, Chanderdeepghat, Lalbegiaghat, Mussoorie and Motihari 16 each, Karchhana, Azamgarh, Kessariah, Chauldhowaghat and Garubathan 15 each, Seodha (Seondha), Chatia, Chhatnag, Jandhaha and Mushari 14 each, Patahi, Jhanjharpur and Hata 13 each, Hasanpur, Deogaon Lalganj, Haldwani, Baltara, Allahabad AP, Benibad, Karandighi, Sheohar, Kolkata AP, Cheria B.Pur, Pusapatirega, Jollygrant and Sahebganj 12 each
12 Jul	Jogindarnagar 18, Haldwani 17, Gudh 16, Rewa, Amritsar IAF, Nainital and Tibri 15 each, Mohammedabad (Y), Sono, Satna, Nagode and Koraon 14each, Sirmari B. Pur and Kursela 13 each, Manihari 12
13 Jul	Khurai and Kasarwad 17 each, Suri Cwc, Khandwa and NH5 Gobindpur 16 each, Jagadhari 15, Kakatpur and Buxwaha 14 each, Katni - AWS 13, Khargaon, Matijuri, Kurwai, Nahan and Damoh 12 each
14 Jul	Ghatol, Pen, Pipalkhunt and Karjat agri 24 each, Dug 23, Matheran, Bhungra, Quepem and Lonavala agri 20 each, Igatpuri and Mount Abu 19 each, Mounnt Abu Tehsil and Bhira 18 each, Susner, Sanguem, Canacona and Bagidora 17 each, Sudhagad Pali, Khilchipur, Kankavli, Mulki and Jagpura 15 each, Khalapur, Khachrod, Loharia and Kudal 14 each, Nanipalson, Valpoi, Sabla, Shirali PTO, Bakani, Gangdhar, Mahidpur, Kota, Depalpur and Trimbakshwar 13 each, Mokheda - FMO, Danpur and Banswara 12 each
15 Jul	Chotila 45, Rajkot 35, Tankara 34, Kaprada 26, Alipingal and Kantapada ARG 19 each, Kakatpur and Jagatsinghpur AWS 18 each, Mount Abu, Murbad and Peth 17 each, Matheran, Muli, Paddhari and Ozharkheda - FMO 16 each, Mounnt Abu Tehsil and Igatpuri 15 each, Kapadvanj, Harsul - FMO, Surendranagar, Raniwada and Poshina 14 each, Nanipalson, Kalol (G), Wankaner, Madhbun, Astaranga ARG, Danta, Mahabaleshwar and Jawhar 13 each, Jamnagar IAF, Trimbakshwar and Mungeli 12 each
16 Jul	Abdasa 32, Naliya 29, Jodia 26, Kashipur and Dasada 24 each, Dhrangadhra 17, Peth, Morbi and Palampur 16 each, Baijnath and Chotila 15 each, Matheran and Kharaghoda 14 each, Nuagada ARG and Bagrakote 13 each, Dongargaon, Sutrapada, Nanipalson, Alipingal, Lodhika, Talasari, Gir Gadhada and Ozharkheda - FMO 12 each
17 Jul	Narla ARG 39, Ambadola and Lanjigarh 25 each, Bhavani P. 18, Madanpur Rampur 17, Cuttack and Mundali 15 each, Binika 14, Kakatpur, Mhasla, Mahad and Pen 13 each, Mahabaleshwar and Jharbandh ARG 12 each

TABLE 3 (*Contd.*)

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
18 Jul	Valsad 28, Pardi and Dondilohara 27 each, Chikhli 25, New Kandla 24, Daman, Dharampur and Gandevi 20 each, Palampur 19, Khergam 18, Kosagumda, Alibag and Bhira 17 each, Kanker, Mumbai (SCZ), Roha, Jogindarnagar and Pen 16 each, Harnai, Mahabaleshwar, Matheran, Lanja, Tala, Uran, Mhasla, Banjar and Panvel agri 15 each, Tentulikhunti ARG, Murud, Balod, Kheri, Sudhagad Pali, Mangaon and Belapur (Thane) 14 each, Nagpur AP, Dabugan ARG, Nagrota Surian, Ratnagiri, Mahad, Dahanu, Karjat agri, Banki ARG, Tibri, Bhiwandi and Dharmasala 13 each, Lonavala agri, Kaprada, Ambagarh Chowki, Baijnath, Jagdalpur, Jeypore, Talasari, Thane and Kamptee 12 each
19 Jul	Bhamragad 34, Chamorshi 26, Bramhapuri 21, Choryasi, Harnai, Bhagamandala and Dabugan ARG 20 each, Sawantwadi, Jagdalpur, Sindewahi, Jhorigam ARG and Kudal 19 each, Mulde Agri, Mahabaleshwar and Poladpur 18 each, Mul 17, Chandgad, Valpoi, Mandangad and Chandahandi ARG each; 15 - Agumbe, Kosagumda, Kalyan, Radhanagari, Kottigehara and Jaipatna 16 each, Dharmagarh ARG, Shriwardhan, Dantewara and Ulhasnagar 14 each, Deobhog, Kankavli, Murud, Chikhli, Bhira, Chauldhowaghat, Raighar ARG, Etapalli, Pauni, Bhiwandi, Pombhurna, Golaghat, Tentulikhunti ARG, Ahiri, Chiplun, Vaibhavwadi and Dapoli agri 13 each, Gaganbawada, Linganamakki HMS, Pachmarhi, Mhasla, Ambernath, Gadchiroli, Gersoppa, Vasai, Mahad, Mulchera, Wakwali agri, Kammardi, Mangaon, Cherrapunji, Siddapura, Vengurla, Rajapur, Warora, Ponda and Karjat agri 12 each
20 Jul	Bhagamandala 29, Ponnampet Pwd 27, Radhanagari 22, Kottigehara 21, Agumbe 20, G Bazar, Chiplun, Chandgad and Naduvattam 19 each, Guhagarh 17, Harnai, Hosanagara and Dapoli agri 16 each, Virajpet, Risod, Lanja and Gaganbawada 15 each, Jaspur, Bhira, Kammardi, Wakwali agri, Vaibhavwadi, Mahabaleshwar, Roha and Chicholi 14 each, Sawantwadi, Vythiri, Napoklu, Ratnagiri, Rajapur and Kalasa 13 each, Sangameshwar Devrukh, Medikeri, Kadra, Mudigere and Kankavli 12 each
21 Jul	Hosanagara 21, Tantloi 16, Suri Cwc, Belonia, Veraval and Kodinar 15 each, Rajnagar, Igatpuri, Mahabaleshwar and Lonavala agri 14 each, Matheran, Talasari and Velhe 13 each, Radhanagari, Jabalpur, Sabroom, Linganamakki HMS, Sutrapada, Narayanpur, Umergam and Amarpur 12 each
22 Jul	Chotila 33, Vadia 25, Durgachak 24, Visavadar 23, Nandigram 22, Matheran and Lonavala agri 20 each, Ranpur and Sagar 19 each, Bhesan and Amreli 18 each, Thangadh and Jawhar 17 each, Jasdan 16, Igatpuri 15, Lathi, Velhe, Kamrej and Vadodara City 14 each, Vanthali, Diamond Harbour, Bagasra, Sayla, Gohar, Rajula and Lilia 13 each, Jetpur, Pen, Veraval, Junagadh, Jhalda, Muli, Pingla and Bhira 12 each
23 Jul	Bankura 27, Kalol (G) 22, Deodar 20, Bankura Cwc 19, Salumber and Lonavala agri 17 each, Baijnath and Gohar 16 each, Jalore, Matheran, Trimbakshwar, Tensa and Uluberia 15 each, Mahudha, Gurundia ARG, Mount Abu, Contai and Igatpuri 14 each, Jawhar, Erinpura Rd., Sumerpur, Mounnt Abu Tehsil, Palghar agri, Pen, Gangrar, Mahemdavad and Vikramgad 13 each, Tiring, Tarapur, Desuri, Surgana and Ahore 12 each
24 Jul	Mounnt Abu Tehsil 77, Mount Abu 73, Reodar 40, Raniwada 39, Sirohi 38, Dantiwada 34, Pindwara 30, Abu Road 27, Bhinmal 26, Palanpur, Deesa and Amirgadh 25 each, Dhanera, Erinpura Rd., Sumerpur and Jamshedpur AP 23 each, Lakhani 22, Vadgam and Tensa 20 each, Jaswantpura 19, Danta 18, Sheoganj, Jamshedpur, Deodar, Kashipur and Kotda 17 each, Poshina, Satlasana and Mahabaleshwar 15 each, Katra, Mawsynram, Vijaynagar, Champua, Dharoi Colony, Sanchore, Bali and Sayla 14 each, Desuri, Kherwara, Patan, Lonavala agri, Purihansa and Khedbrahma 13 each, Vadali, Panposh, Hatwara, Pali, Kankrej, Saraswati, D.P.Ghat, Tharad, Joda ARG, Manmothnagar and Siddhpur 12 each
25 Jul	Mount Abu and Mounntabu Tehsil 73 each, Dantiwada 46, Reodar 45, Sanchore 39, Palanpur 38, Vadgam 36, Amirgadh 34, Lakhani 31, Sirohi 30, Patan 29, Deodar 28, Dhanera, Abu Road and Deesa 27 each, Mawsynram 24, Gudamalani and Bankura 23 each, Saraswati 22, Dharoi Colony 20, Kunda, Modasa, Khedbrahma and Wav 19 each, Siddhpur, Baheri, Cherrapunji, Tharad and Poshina 18 each, Bhabhar, Veja, Bhiloda, Cherrapunji (Rkm), Raniwada and Danta 17 each, Kashipur, Jaswantpura, Vadali and Himatanagar 16 each, Kankrej, Idar, Bankura Cwc and Dhansura 14 each, Talod, Amta, Mansa, Purihansa, Prantij and Vijapur 14 each, Kalol (G), Jamshedpur, Hatwara, Kheralu and Satlasana 13 each, Vijaynagar, Radhanpur, Suigam, Asansol, Varanasi AP, Mahabaleshwar, Dorimanna, Lunglei, Becharaji and D.P.Ghat 12 each
26 Jul	Mount Abu and Mounnt Abu Tehsil 32 each, Himatanagar 22, Ranchi AP 21, Amirgadh 15, Dhanera 14, Banswara, Desuri and Daltonganj 13 each, Jaswantpura, Jamshedpur and Bankura 12 each
27 Jul	Gandhinagar 26, Dhansura 20, Gohar and Ahmedabad 18 each, Manteswar 17, Mount Abu and Mounnt Abu Tehsil 15 each, Dahegam 14, Kalol (G), Ambikapur and Mahemdavad 13 each
28 Jul	Dharampur 30, Waghai 27, Kalol (G) 25, Mahuva 24, Narsingarh 23, Kaprada 22, Raisen 21, Kadi and Dug 19 each, Vansda 18, Khergam and Vyara 17 each, Valsad 16, Becharaji and Pardi 15 each, Harsul - FMO, Dangs (Ahwa) and Vapi 14 each, Valod, Gangdhar, Daman, Chabra, Nanipalson and Bhinmal 13 each, Chikhli, Bareli, Kheri, Surgana and Agar 12 each
29 Jul	Pratapgarh 24, Kaprada 22, Rashmi 16, Nimbahera, Champasari and Bakani 15 each, Salbari, Tribeni / Balmiki and Bhoranj 14 each, Chhotisadri, Dug, Gohar, Kapasan, Chittorgarh, Asnawar and Pachpahar 13 each, Jhalarapatan, Harsul - FMO, Pindwara, Mahabaleshwar, Lunglei and Mangliawas 12 each
30 Jul	Cheria B.Pur 14, Tindivanam 12
31 Jul	Baheri 20, Dehra Gopipur 16, Rajghat, Palampur and Nawabganj 13 each
1 Aug	Kangra AP and Baijnath 18 each, Kumargram 15, Annapurnaghat 13, Athgarh and Palampur 12 each

TABLE 3 (*Contd.*)

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
2 Aug	Patiala Rev and Maduranthagam 15 each, Pullambadi 14, Chengam and Patiala 13 each, Vadipatti 12
3 Aug	Gaunaha 13, Dehra Gopipur and Nellimarla 12 each
4 Aug	Tribeni / Balmiki 30, Kotdwar 25, Sarkaghat 19, Gaunaha 18, Bantwal 16, Agumbe 15, Barapani 13, Ramnagar 12
5 Aug	Jamshedpur 19, Kasauli 17, Jollygrant and Hardwar 15 each, Vadakara 14, Tibri 13, Dharampur, Baijnath and Dehra Gopipur 12 each
6 Aug	Tirtol ARG 20, Naraingarh and Sarkaghat 19 each, Banganaf 15, Tinsukia and Ghamroor 14 each, Naina Davi, Dehri and Banganar 13 each, Marsaghai ARG 12
7 Aug	Dehra Gopipur 17, Bhoranj 16, Sarkaghat 14, Dharmasala 13, N. Lakhimpur, Haldibari and Pali 12 each
8 Aug	Buxaduar 23, Amb, Ranjit Sagar Dam Site and Chengmari / Diana 19 each, Bhiwapur 18, Alipurduar Cwc 16, Phangota 15, Naina Davi 14, Tezu, Nagaon and Kumargram each, Kawardha 12
9 Aug	Haldibari 25, Mawsynram and Cherrapunji 23 each, Cherrapunji (Rkm) 20, Roing 19, Korchi 17, Chothkabarwara and Arjuni Morgaon 16 each, Passighat 15, Cooch Behar and Kumargram 14 each, Pattukottai and Adirampattinam 13 each, Lakhandur, Mathabhanga, Kuhi, Dondilohara and Dharmasala 12 each
10 Aug	Mawsynram 33, Haldibari 27, Roing 26, Cherrapunji (Rkm) 24, Alipurduar and Alipurduar Cwc 23 each, Kumargram 22, Jaithari 19, Passighat, Gossaigaon and Samakhunta AWS 18 each, Cherrapunji, Domohani and NH31 Bridge 17 each, Gaunaha 16, Jammu 15, Barobhisha 14, Tiruvuru (Arg), Mathabhanga, Chittoor, Jalpaiguri, Tuting, Mohitnagar, Dalhousi Alha AWS and Thanjavur 13 each, Aie Nh Xing, T Narasipur, Shahpur Kandi and Royachoti 12 each
11 Aug	Mawsynram 50, Cherrapunji (Rkm) 38, Cherrapunji 30, Kokrajhar 28, Roing 26, Cooch Behar 25, Gossaigaon and Passighat 23 each, Shillong and Baheri 20 each, Aie Nh Xing and Panbari 19 each, Hasimara and Kottayam 18 each, Haldibari and Alipurduar 17 each, Nagarkata, Rosera, Dinhata, Taibpur and Baghdogra AP 16 each, Goibargaon, Mathabhanga, Arundhutinagar, Tezu and Kumargram 15 each, Beki Mathungari, Galgalia, Didihat, Gajoldoba, Jaspur, Barobhisha and Tribeni / Balmiki 14 each, Alipurduar Cwc, Sabroom, Drf, Chepan, Neora and Williamnagar 13 each, Nawabganj Tehsil, Mukhlispur, Hardwar, Thakurganj, Murti, Buxaduar and Goalpara cwc 12 each
12 Aug	Hasimara 48, Buxaduar 45, Barobhisha 44, Mawsynram 41, Alipurduar Cwc and Haldibari 39 each, Gossaigaon 37, Kumargram 35, Bahadurganj and Chepan 32 each, Taibpur 31, Jalpaiguri and Nh31 Bridge 29 each, Cherrapunji 28, Kishanganj and Mohitnagar 27 each, Panbari 26, Domohani, Galgalia, Forbesganj and Thakurganj 25 each, Aie Nh Xing 24, Garubathan, Cooch Behar and Chengmari / Diana 23 each, Cherrapunji (Rkm), Williamnagar and Kokrajhar 22 each, Beki Mathungari, Tapan and Murti 21 each, Dinhata and Sonbarsa 20 each, Mathabhanga, Kaliaganj and Dumka 19 each, Neora and Bagrakote 17 each, Raiganj and Agumbe 16 each, Araria, Gangarampur, Lunglei, Sevoke and Serchip (Hydro) 15 each, Manash Nh Xing, Gajoldoba, Arundhutinagar and Chargharia 14 each, Roing, Dhengraghat and Bairgania 13 each, Bhimnagar, Pusapatirega, Barpeta, Beky Rly.Bridge, Nagarkata and Gaunaha 12 each
13 Aug	Birpur 45, Gaunaha and Bagaha 37 each, Bahadurganj 36, Ramnagar 35, Kishanganj 29, Taibpur 26, Gangarampur, Forbesganj and Darbhanga 25 each, Dhengraghat 24, Thakurganj 23, Bhimnagar and Chanchal 22 each, Tapan, Cherrapunji and Galgalia 21 each, Karandighi 20, Haldibari, Maharajganj and Mawsynram 19 each, Kaliaganj, Saulighat, Kakrahi and Cherrapunji (Rkm) 18 each, Madhwapur and Araria 17 each, Sonbarsa 16, Purnea, Kamtaul, Kumargram and Williamnagar 15 each, Raiganj, Garubathan, Tribeniganj, Tribeni / Balmiki, Mangan, Lunglei, Basua, Gossaigaon, Rosera, Barobhisha, Pusa and Polur 14 each, Nirmali, Drf, Kodawanpur / C.Bii, Sukiapokhri and Hayaghat 13 each, Samastipur, Chepan, Bagrakote and Sapaul 12 each
14 Aug	Tribeni / Balmiki 40, Mawsynram 39, Kakrahi 30, Cherrapunji and Cherrapunji (Rkm) 25 each, Maharajganj and Bhinga Hmo 21 each, Gorakhpur 18, Bhinga 15, Bansi Cwc and Regoli 14 each, Bagaha and Mehre (Barsar) 13 each, Balrampur, Nanpara, Williamnagar and Utarala 12 each
15 Aug	Bengaluru Hal AP and Kalyan 14 each, Mandya and Bengaluru City 13 each, Kakerdarighat and Salempur 12 each
16 Aug	Buxaduar 25, Mawsynram 18, Amarpur and Tribeni / Balmiki 13 each
17 Aug	Burla ARG 18, Long Islands 13, Kirmira ARG 12
18 Aug	Kailashahar 15, Dharmanagar / Panisagar 13
19 Aug	Naraingarh 17, Umrer, Khandwa and Khandwa - AWS 15 each, Kamptee, Nagpur AP and Mauda 14 each, Red Hills, Dondilohara, Kawardha and Khategaon 13 each, Nagbhir and Perseoni 12 each
20 Aug	Pipalkhunt 22, Nanded 21, Mudkhed 20, Ranjal, Nallabelly and Naigaon Khairgaon 19 each, Navipet, Dharmabad, Mudhole and Venkatapur 18 each, Sarangapur, Ausa, Nizam Sagar and Kotgiri 17 each, Varni, Shayampet and Yellareddy 16 each, Atmakurwrgl, Osmanabad, Latur, Bodhan and Jagpura 15 each, Umari, Deoni, Mulug and Govindaraopet 14 each, Narayankhed, Rudrur AP, Ardhapur, Danpur and Nilanga 13 each, Adampur IAF, Sukma, Manki, Pitlam, Jukkal, Pen, Banswada and Gandhari 12 each

TABLE 3 (*Contd.*)

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
21 Aug	Nevasa 19, Ambernath 17, Gangapur 16, Kalyan and Matheran 15 each, Murbad, Pen, Shevgaon and Rahuri 14 each, Ambad, Phagwara, Ulhasnagar, Bhiwandi, Shahapur, Partur, Ahmednagar and Vasai 13 each, Thane, Shrirampur, Vaijapur, Selu, Uran, Mumbai (SCZ), Belapur (Thane), Trimbakshwar, Agumbe and Karjat agri 12 each
22 Aug	Jagadhari and Gadhda 17 each, Mangrol and Mangrol (J) 16 each, Malia 13, Sutrapada 12
23 Aug	Karwi 15, Naraingarh, Budaun and Nighasan 13 each
24 Aug	Bhoranj 13
25 Aug	Owk 20, Duvvur 15, Siddapura and Chapad 13 each, Uchchhal 12
26 Aug	Bhira 22, Vikramgad 20, Sudhagad Pali 17, Uran 16, Vansda 14, Lonavala agri and Vaibhavwadi 13 each, Pen, Machareddy, Jharnapani, Roha, Sadasivanagar and Gohar 12 each
27 Aug	Chanchal 21, Sailana and Williamnagar 16 each, Renapur 15, Cherrapunji, Ulhasnagar, Cherrapunji (Rkm), Lonavala agri and Agumbe 14 each, Taibpur 13, Gersoppa and Ambernath 12 each
28 Aug	Tentulikhunti ARG 23, Chanchal 19, Tilakwada 17, Lucknow AP, Haldwani and Kurupam 16 each, Gairsain, Kaiserganj and Halol 14 each, Sankheda 13, Pratapgarh, Narla ARG and Palasa 12 each
29 Aug	Vapi 41, Silvassa 29, Pen 26, Mokheda - FMO and Mhasla 21 each, Jawhar 20, Dahanu, Bhira, Talasari and Umergam 19 each, Madhbun and Harnai 18 each, Mandangad, Uran and Mahabaleshwar 17 each, Nanipalson and Alibag 16 each, Tala, Mumbai (Colaba) and Budhni 15 each, Roha, Hoshangabad, Shahapur, Matheran, Ozharkheda - FMO and Daman 14 each, Vikramgad, Kalyan, Guhagarh, Murbad, Ulhasnagar, Murud, Ambernath and Irikkur 13 each, Panvel agri, Poladpur, Pardi, Chiplun, Khed, Bhagamandala, Sulya and Sangameshwar Devrukh 12 each
30 Aug	Mumbai (SCZ) 33, Palghar agri 28, Thane 25, Lonavala agri 21, Keshod, Pen and Mangrol (J) 20 each, Matheran 19, Daman 17, Manavadar 15, Khambhalia, Vasai, Diu, Bhira, Vapi and Khandwa 14 each, Bhalukpong, Sudhagad Pali, Malia, Ulhasnagar and Kalyanpur 13 each, Upleta, Silvassa, Buxaduar, Amarkantak, Umergam and Belapur (Thane) 12 each
31 Aug	Khambhalia 17, Kodinar 15, Murti 14, Kalyanpur 13, Neora and Lalpur 12 each
1 Sep	Gaunaha 19, Dehra Dun and Haldwani 15 each, Moga, Chatargarh and Udaipur 12 each
2 Sep	Natham 17, Karur and Mawana 16 each, Indri, Haldwani and Kumargram 15 each, Buxaduar, Tajewala, Rajpura, Aravakurichi and Paonta 14 each, Kurukshetra AWS, Nilokheri, Karnal, Hardwar, Nahan and Kaithal 13 each, Nagina, Moradabad Cwc, Jaspur, Naina Davi, Peraiyur, Alangayam, Hasimara and Karnal Rev 12 each
3 Sep	Cherrapunji and Katra 14 each, Chauldhowaghat 13
4 Sep	Mangan 15
5 Sep	Uttamapalayam 24, Malbazar ARG 18, Nagarkata 17, Neora 16, Chengmari / Diana 15, Kangeyam 12
6 Sep	Bhalukpong 15, T Narasipur 14, Mysuru, Mavelikara, Krishnarajasagara and Barobhisha 12 each
7 Sep	Nil
8 Sep	Baramati 13
9 Sep	Mawsynram 35, Cherrapunji (Rkm) 21, Cherrapunji 17, Kumbakonam 16, Garubathan and Chittoor 13 each
10 Sep	Cherrapunji 22, Garubathan 21, Melabazar / Matunga 20, Majbhat and Beki Mathungari 16 each, Magadi and Baghdogra AP 14 each, Miao, Drf and Cherrapunji (Rkm) 13 each, Panbari, Rolla and Baijnath 12 each
11 Sep	Garubathan 27, Agartala AP 13, Manjeri 12
12 Sep	Buxaduar 15
13 Sep	Renapur 16, Banki ARG 15, Amarpur, Ankola, Jamshedpur and Siswan 13 each
14 Sep	Peermade To and Nilambur 17 each, Kerur and Karimganj 12 each
15 Sep	18 - Gaunaha; 16 - Samba AWS; 14 - Shriwardhan; 13 - Settur
16 Sep	Nil
17 Sep	Mannarkad 23, Angadipuram 19, Vadakara 18, Perinthalamanna 16, Piravam 15, Kesinga ARG and Polavaram 13 each, Konni, Perumpavur, Vellanikkara, Mulki and Kodungallur 12 each
18 Sep	Mulde Agri 18, Contai and Kudal 16 each, Malvan and Ernakulam South 15 each, Kankavli and Contai 14 each, Ranibandh 13, Mavelikara 12

TABLE 3 (*Contd.*)

Date	Some representative amounts of rainfall in cm for June, July, August and September 2017 (12 cm and above)
19 Sep	Harnai 37, Wakwali agri 29, Dapoli agri 26, Chiplun 22, Mulde Agri 18, Kirmira ARG 17, Kudal 16, Tangi and Laikera 15 each, Nawarangpur, Jujumura ARG, Kankavli and Mandangad 14 each, Malvan 13, Bhagamandala, Birmaharajpur ARG, Chandbali, Barkote, Banki ARG, Kolabira ARG, Rajapur, Mhasla and Mahabaleshwar 12 each
20 Sep	Vasai 37, Matheran 36, Dahanu 31, Mumbai (SCZ) 30, Panvel agri and Mahabaleshwar 25 each, Uran 24, Harnai and Pen 22 each, Mumbai (Colaba) and Wada 21 each, Karjat agri, Mokheda - FMO and Jawhar 20 each, Vikramgad 19, Ulhasnagar and Pernem 18 each, Ambernath, Murbad and Umergam 17 each, Kalyan and Palghar agri 16 each, Khalapur, Mhasla, Belapur (Thane) and Lanja 15 each, Dapoli agri, Bhiwandi, Thane and Bhira 14 each, Alibag and Mawsynram 13 each, Pedong, Jaipatna, Talasari, Narla ARG, Shriwardhan and Mandangad 12 each
21 Sep	Dondilohara 21, Chiplun 18, Shrirampur 16, Sagar and Rahuri 13 each, Garhakota and Bhiwandi 12 each
22 Sep	Harnai 32, Isagarh 26, Chanderi 20, Mungaoli and Kurwai 19 each, Kakrahi 18, Karera 16, Pichhore and Haidargarh 15 each, Ramnagar, Shajapur, Shajapur - AWS and Mhasla 14 each, Ashoknagar - AWS, Lalitpur and Shahjahanpur T 13 each, Chiplun, Bhira and Dapoli agri 12 each
23 Sep	Bah 28, Chhansa 23, Ballabgarh 19, Nainital and Faridabad 15 each, Khair 14, Bijnor, Beki Mathungari and Sikandarabad 13 each, Nazibabad, Faridabad AWS, Aligarh, Nagina, Ganaur and Palwal 12 each
24 Sep	16 - Nahan; 15 - Hardwar; 14 - Moradabad Cwc; 13 - Rajgarh; 12 - Renuka / Dadhau, Bijnor and Moradabad each
25 Sep	Namthang 15, Davanagere 13, Majitar 12
26 Sep	Nil
27 Sep	Mysuru PTO 14
28 Sep	Karkala 15
29 Sep	Kankavli 14, Mawsynram and Cherrapunji 13 each
30 Sep	Goalpara cwc 35, Goalpara 29, Mawsynram 23, Williamnagar 19, Manash Nh Xing 17, Aie Nh Xing 15, Kokrajhar, Cherrapunji, Cooch Behar and Narsipatnam 14 each, Chepan and Gossaigaon 12 each

other two geographical regions received above normal rainfalls (17% and 16 % of LPA respectively for East & Northeast and South Peninsula); Out of the 6 *excess* subdivisions, 3 each were from East & Northeast India (Sub-Himalayan West Bengal, Arunachal Pradesh and NMMT) and South Peninsula (coastal Andhra Pradesh) and 2 sub-divisions from central India (Saurashtra & Kutch and Marathwada). 2 *large excess* were the Tamil Nadu region and Rayalseema.

In September, 7 subdivisions were *excess* and 2 *large excess*, 14 subdivisions were *deficient* and 13 subdivisions were *normal*. The region that mainly benefited during September was South Peninsula with 7 out of 10 su-bdivisions from the region (except Telangana (-29% of LPA) receiving *excess* (6 subdivisions) or *normal* rainfall resulting in *excess* rainfall (26% of LPA) over the region. In addition, 2 su-bdivisions from Central India (Konkan & Goa and Madhya Maharashtra) and one subdivision from northeast (NMMT) also received *excess* rainfall. However, the other 3 geographical regions experienced noticeable rainfall deficiency (-38 % of LPA for Northwest India with *deficient* subdivisions, -14% of LPA for East and Northeast India with 6 *deficient* subdivisions and -14% of LPA for Central India with 4 *deficient* subdivisions).

2.3. *Seasonal rainfall distribution*

Meteorological sub-division wise seasonal rainfall distribution in terms of percentage departures from *normal* is given in Fig. 6. Out of the total 36 meteorological subdivisions, the seasonal rainfall was *normal* in 25 sub-divisions and *deficient* in 6 subdivisions. Five sub-division *viz.*, Nagaland-Manipur-Mizoram-Tripura, west Rajasthan, Saurashtra & Kutch, Rayalaseema and Tamil Nadu received *excess* rainfall and no sub-division reported *large excess and large deficient* rainfall by the end of the season. Out of the 6 *deficient* subdivisions, 4 subdivisions were from north India and 2 from central India.

Table 3 contains the representative amounts of very heavy and extremely heavy rainfall observed during the season.

2.4. *Withdrawal of southwest Monsoon*

Fig. 7 shows the isochrones of withdrawal of SWM.

Dry weather prevailed over western parts of Rajasthan since 18th September. However, the changeover of atmospheric circulation pattern was delayed. Establishment of an anti-cyclone in the lower tropospheric

TABLE 4

Details of the weather systems during June 2017

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.	Deep Depression	11 (1200 UTC) - 12	Northwest & adjoining northeast Bay of Bengal centered near Lat. 20.5° N/ Long. 89.5° E	Northeast	Eastern parts of Bangla Desh and neighbourhood centered near Lat. 24.5° N/ Long. 91.5° E	Details are given in the article on Storms & Depressions over the north Indian Ocean - 2017
(**B**)	*Well marked low pressure area*					
1.	Well marked Low Pressure area	6 - 8	West central Arabian Sea and neighbourhood	Northwest	West central Arabian Sea and adjoining coastal Oman	It formed under the influence of a cyclonic circulation extending between lower and mid tropospheric levels over west central Arabian Sea and neighbourhood on 5. Became un-important on 9. Associated cyclonic circulation extended upto mid tropospheric levels
2.	Low Pressure area	15 (12 UTC) - 16	Northwest Bay of Bengal and neighbourhood	North	Southwest Bangla Desh and neighbourhood	It formed under the influence of cyclonic circulation extending between mid & upper tropospheric levels over northwest and adjoining west central Bay of Bengal off south Odisha-north Andhra Pradesh coast. It became less marked on 16 evening. Associated cyclonic circulation extended upto 4.5 kms a.s.l. on 16 and upto lower levels on 17 & 18 and became less marked on 19
3.	Well marked Low Pressure area	25 - 26 (0000 UTC)	Northwest Bay of Bengal and adjoining coastal areas of Odisha and Gangetic West Bengal	Stationary	*In-situ*	It formed under the influence of a cyclonic circulation extending upto upper tropospheric levels over north Bay of Bengal and neighbourhood. It became less marked on 26. Associated cyclonic circulation (IV-10) extended upto upper tropospheric levels tilting southwards with height upto 1 July
4.	Low Pressure area	28 - 30	Saurashtra and adjoining northeast Arabian Sea	East	Kutch and neighbourhood	Became less marked on 1July. Associated cyclonic circulation extended upto mid tropospheric levels
(**C**)	*Western disturbances / Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	Upto Mid tropospheric levels	6 - 7	North Pakistan and neighbourhood	Northeast	North Pakistan and adjoining Jammu & Kashmir	It became less marked on 8. Initially it lay as a trough in westerlies with its axis at 3.1 kms a.s.l. during 3 - 5
2.	Upto lower tropospheric levels	6 - 14	Central Pakistan and neighbourhood	Oscillatory	Central Pakistan and adjoining west Rajasthan	It became less marked on 15
3.	Upto Mid tropospheric levels	9 - 13	North Pakistan and neighbourhood	Northeast	Eastern parts of Jammu & Kashmir and neighbourhood	It moved away east-northeastwards on 14. A trough lay aloft with its axis at 5.8 kms a.s.l. during 9 -12 and moved away northeastwards on 13
4.	Between mid & Upper tropospheric levels	18 - 23	Northeast Afghanistan and adjoining north Pakistan	Do	Himachal Pradesh and neighbourhood	It moved away east-northeastwards on 24. It lay as a trough in mid & upper tropospheric levels on 20 and then aloft with its axis at 9.5 kms a.s.l. during 21-23

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5.	Between 3.1 & 5.8 kms a.s.l.	30 Jun - 2 Jul	Northeast Afghanistan and adjoining north Pakistan	Northeast	Jammu & Kashmir and adjoining north Pakistan	It moved away northeastwards on 3 July
(*ii*)	*As a trough*					
1.	Upto Mid tropospheric levels	26 - 29	Along Long. 64° E to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	East	Along Long.71° E to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	Moved away northeastwards on 30
(**D**)	*Other upper air cyclonic circulations*					
1.	Upto lower tropospheric levels	2	Western parts of Vidarbha and neighbourhood	Stationary	*In-situ*	Became less marked on 3
2.	Do	5 - 6	Assam & Meghalaya and neighbourhood	Do	Do	Became less marked on 7
3.	Do	5 - 10	East Uttar Pradesh and adjoining Bihar	East	South Bihar and neighbourhood	It became less marked on 11
4.	Mid tropospheric levels	6 - 8	East central Bay of Bengal and adjoining north Andaman Sea	Quasi-stationary	North Andaman Sea and neighbourhood	Became less marked on 9
5.	Upto lower tropospheric levels	11	Haryana and neighbourhood	Stationary	*In-situ*	It became less marked on 12
6.	Between 3.1 & 5.8 kms a.s.l.	12	South Konkan and adjoining Madhya Maharashtra	Do	Do	It merged with the trough from south Chhattisgarh and neighbourhood to south Konkan on 13
7.	At lower level	13	Haryana and neighbourhood	Do	Do	It became less marked on 14
8.	Upto lower tropospheric levels	13 - 15	East Uttar Pradesh and neighbourhood	East	Southwestern parts of Bihar and neighbourhood	It became less marked on 16
9.	Do	16 -17	Northwest Madhya Pradesh and adjoining southern parts of Uttar Pradesh	Do	Southwest Uttar Pradesh and neighbourhood	Became less marked on 18
10.	Do	16-18	Haryana and neighbourhood	Stationary	*In-situ*	Became less marked on 19
11.	Between 3.6 & 4.5 kms a.s.l.	18	South Konkan and adjoining Madhya Maharashtra	Do	Do	Became less marked on 19
12.	Between lower & mid tropospheric levels	18-19	Southwest Rajasthan and neighbourhood	Do	Do	It became less marked on 20
13.	Upto lower tropospheric levels	19-20	Sub-Himalayan West Bengal and neighbourhood	East	Northern parts of Bangla Desh and neighbourhood	Became less marked on 21
14.	Do	20	Northwest Rajasthan and neighbourhood	Stationary	*In-situ*	It became less marked on 21
15.	Upto mid and upper tropospheric levels	21 Jun - 1 Jul	Coastal Odisha and neighbourhood	East	Bihar and adjoining east Uttar Pradesh.	Under its influence a low pressure area formed over northwest Bay of Bengal and adjoining coastal areas of Odisha and Gangetic West Bengal. The cyclonic circulation remained associated with the low pressure area (II-3) from 25 to 26. It became less marked on 2 July

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
16.	At Lower levels	21	Northwest Madhya Pradesh and neighbourhood	Stationary	*In-situ*	Became less marked on 22
17.	Between mid & upper tropospheric levels	24	Southeast Rajasthan and neighbourhood	Do	Do	It became less marked on 25
18.	Between lower & mid tropospheric levels	25 - 27	South Gujarat and neighbourhood	Do	Do	It merged with the cyclonic circulation associated with the low pressure area over Saurashtra and adjoining northeast Arabian Sea on 28
19.	Upto Lower tropospheric levels	26 - 28	Eastern parts of Assam and neighbourhood	Do	Do	It became less marked on 29
20.	Upto mid tropospheric levels	29 Jun - 2 Jul	Northwest Bay of Bengal and adjoining coastal areas of West Bengal	West	Jharkhand and Gangetic West Bengal	It became less marked on 3 July
21.	Between 4.5 & 5.8 kms a.s.l.	30 Jun - 2 Jul	Northwest Bay of Bengal and adjoining west central Bay of Bengal off south Odisha-north Andhra Pradesh coast	Northeast	Northwest Bay of Bengal and neighbourhood	It became less marked on 3 July
22.	Upto mid tropospheric levels	30 Jun - 3 Jul	Northwest Rajasthan and neighbourhood	East	Haryana and neighbourhood	It became less marked on 4 July
(**E**)	*East-West trough*					
1.	At Mean sea level	13 Jun - 18 Jul	From northwest Uttar Pradesh to Assam across northern parts of Uttar Pradesh and Bihar	Oscillatory	Southwest Rajasthan to east central Bay of Bengal across east Rajasthan, Madhya Pradesh, Chhattisgarh and centre of Depression over northwest & adjoining west central Bay of Bengal and coastal areas of Odisha	It was established as Monsoon Trough on 19 July
(**F**)	*Other troughs / wind discontinuity*					
1.	At lower levels	2	Bihar to north Chhattisgarh across Jharkhand	Stationary	*In-situ*	Became less marked on 3
2.	Do	8 - 9	From cyclonic circulation over south Bihar and neighbourhood to Chhattisgarh	Oscillatory	From cyclonic circulation over south Bihar and neighbourhood to interior Odisha across Chhattisgarh	It became less marked on 10
3.	Between lower & mid tropospheric levels	14 - 15	From eastern parts of Bihar to south coastal Odisha	Do	From eastern parts of Bihar to northwest Bay of Bengal	It merged with the cyclonic circulation associated with the low pressure area over northwest Bay of Bengal on 16
4.	Do	17	Sub-Himalayan West Bengal & Sikkim to north Bay of Bengal	Stationary	*In-situ*	It became less marked on 18
5.	Do	19 - 23	From eastern parts of Bihar to south coastal Odisha	Do	From eastern parts of Bihar to northwest Bay of Bengal	It merged with the cyclonic circulation over northwest Bay of Bengal and neighbourhood on 24

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(G) *East-west shear zone*						
1.	Between mid & upper tropospheric levels	6 - 11	Along Lat. 13° N	North	Along Lat. 18° N	It became less marked on 12
2.	Between 3.1 & 3.6 kms a.s.l.	15 - 18	Along Lat. 17° N	Oscillatory	Along Lat. 17° N	It became less marked on 19. Initially it lay as a trough between 3.1 & 5.8 kms a.s.l. during 13 & 14
3.	Between 3.8 & 7.6 kms a.s.l.	26 - 28	Along Lat. 18° N	North	Along Lat. 21° N	It became less marked on 29

levels, substantial reduction in moisture content and prevalence of dry weather indicated the withdrawal of southwest monsoon from some parts of Punjab, Haryana, most parts of west Rajasthan, some parts of Kutch and north Arabian Sea on 27th September. It further withdrew from remaining parts of Punjab, Haryana, Chandigarh & Delhi, west Rajasthan, Kutch, entire Jammu & Kashmir, Himachal Pradesh, some parts of Uttarakhand, west Uttar Pradesh, most parts of east Rajasthan, some parts of west Madhya Pradesh, north Gujarat region, Saurashtra and some more parts of north Arabian Sea on 30th September. A cyclonic circulation which subsequently developed into a Deep Depression in the monsoon flow regime over Gangetic west Bengal caused moisture incursion over the mainland and thereby delayed further withdrawal of southwest monsoon. However, it further withdrew from remaining pats of Uttarakhand, West Uttar Pradesh and East Rajasthan, some parts of East Uttar Pradesh and some more parts of north Madhya Pradesh and Gujarat on 11th October. The presence of cyclonic vortex/trough over the eastern and northern parts of Peninsular India caused rainfall over Bihar, Vidarbha, Gujarat and Chhattisgarh, thus delaying further the withdrawal of South West Monsoon upto 14th October. Thereafter the subdued rainfall activity over the above regions led to withdrwal of the southwest monsoon from entire Uttar Pradesh and Madhya Pradesh, some parts of Gujarat State and some parts of Maharashtra, Chhattisgarh, Jharkhand and Bihar on 15th October. It further withdrew from entire West Bengal & Sikkim, remaining parts of Bihar & Jharkhand, some parts of west Assam & Meghalaya, northwest Bay of Bengal, Odisha, some parts of Chhattisgarh & Madhya Maharashtra and remaining parts of Gujarat and north Arabian Sea on 16th October. The absence of systems over northern & eastern parts extended the subdued rainfall activity to northeastern subdivisions leading to further withdrawal of monsoon from remaining parts of Assam & Meghalaya, entire Arunachal Pradesh, some parts of Nagaland-Mizoram-Manipur-Tripura, some more parts of northwest Bay of Bengal, some parts of northeast Bay of Bengal, remaining parts of Odisha and Chhattisgarh, some parts of coastal Andhra Pradesh, Telangana and some parts of Maharashtra State on 17th October. The formation of low pressure area over Bay of Bengal and its intensification into Depression over the North Bay of Bengal and the troughs over Peninsular India led to increase in rainfall activity over Peninsular India and some parts of northeast India and delayed the further withdrawal of SWM upto 23rd October. It withdrew from remaining parts of northeast India and Maharashtra, some more parts of Bay of Bengal, coastal Andhra Pradesh, Telangana, Karnataka and Arabian Sea on 24th October. With the setting of northeasterly/easterly winds in lower tropospheric levels over the region, southwest monsoon further withdrew from the remaining parts of peninsular India, Bay of Bengal and Arabian Sea and thus from the entire country on 25th October.

3. Chief synoptic features of Southwest Monsoon 2017

The synoptic features which affected the Indian Monsoon region during June, July, August and September are given in Tables (4-7) respectively.

During the season, 14 low pressure systems formed over the Indian subcontinent.

The first intense system formed as a Deep Depression (11-12 June) over northwest and adjoining northeast Bay of Bengal and dissipated over Bangladesh. The second system in June, a well-marked low pressure area, formed over west central Arabian Sea and neighbourhood and dissipated off Oman coast (6-8 June). Two subsequent low pressure systems; a low pressure area (15-16 June) and a well-marked low pressure area (25-26 June) formed over northwest Bay of Bengal. The first one weakened over Bangladesh and northwest Bay of Bengal and adjoining areas of coastal Odisha and the second weakened over Gangetic west Bengal. The last

TABLE 5

Details of the weather systems during July 2017

S. No.	System	Duration	Place of initial location	Direction of movement	Place of Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Deep Depression/Depression*					
1.	Depression	18 (0000 UTC) - 19 (0000 UTC)	Northwest & adjoining west central Bay of Bengal and coastal areas of Odisha centred near Lat. 19.0° N/ Long. 86.0° E	West	Coastal Odisha and neighbourhood centred near Lat. 19.8° N/ Long. 85.3° E	It weakened into a well mark low pressure area over interior Odisha and neighbourhood on 19 morning and as a low pressure area during 20 - 25. Details are given in the article on Storms & Depressions over the north Indian Ocean - 2017
2.	Land Depression	26 - 27 (0000 UTC)	Northwest Jharkhand and neighbourhood centred close to Daltonganj near Lat. 24.0° N/ Long. 84.0° E	Northwest	Southeast Uttar Pradesh and neighbourhood centred near Lat. 25.0° N/ Long. 82.5° E	Details are given in the article on Storms & Depressions over the north Indian Ocean - 2017
(**B**)	*Well marked low/low pressure area*					
1.	Low Pressure area	7 - 8	Northern parts of east Uttar Pradesh and neighbourhood	East	Northeastern parts of Uttar Pradesh and adjoining Bihar	It formed under the influence of a cyclonic circulation extending upto 7.6 kms a.s.l. over Bihar and adjoining east Uttar Pradesh It became less marked on 9. Associated cyclonic circulation extended upto mid tropospheric levels
2.	Well Marked Low Pressure area	11 - 16	East Uttar Pradesh and neighbourhood	Southwest	South Pakistan and neighbourhood	Initially it lay as a cyclonic circulation extending upto mid tropospheric levels over western parts of Bihar and neighbourhood on 10. It became un-important on 17. Associated cyclonic circulation extending upto mid tropospheric levels persisted upto 16 and became un-important on 17
3.	Low Pressure area	20	Kutch and neighbourhood	Stationary	*In-situ*	It moved westward and merged with the Heat low on 21. Associated cyclonic circulation extended upto lower tropospheric levels
4.	Do	21	South Gujarat and neighbourhood	Do	Do	It merged with the low pressure area over southeast Rajasthan and neighbourhood on 22. Associated cyclonic circulation extended upto 7.6 kms a.s.l.
(**C**)	*Western Disturbances /Eastward moving Systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	Between 3.1 & 5.8 kms a.s.l.	4 - 7	North Pakistan and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	Moved away northeastwards on 8. Initially it lay as a trough in mid and upper tropospheric westerlies with its axis at 5.8 kms a.s.l. extended along Long. 72° E to the north of Lat. 32° N on 3
2.	Between 4.5 & 7.6 kms a.s.l.	8 - 10	Central Pakistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	Moved away northeastwards on 10 evening

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Between 3.1 & 4.5 kms a.s.l.	12 - 15	North Pakistan and neighbourhood	East northeast	Jammu & Kashmir and neighbourhood	Moved away east-northeastwards on 16
4.	Upto Mid tropospheric levels	19-24	North Pakistan and adjoining Afghanistan	Northeast	Do	Became less marked on 25. A trough lay aloft during 19 - 24
5.	Do	27 Jul - 4 Aug	Western parts of Afghanistan and neighbourhood	Do	Along Long. 80° E to the north of Lat. 25° N (axis at 5.8 kms a.s.l.)	It lay as a trough between 3.1 & 4.5 kms a.s.l. on 4 and moved away east-northeastwards on 5 August
6.	At 5.8 kms. a.s.l.	28 - 30	West central Bay of Bengal off Andhra Pradesh coast	Oscillatory	West central and adjoining southwest Bay of Bengal off south Andhra Pradesh coast	Became less marked on 31
7.	Upto Mid tropospheric levels	31 Jul - 8 Aug	Iran and neighbourhood	Northeast	Jammu & Kashmir and neighbourhood	It lay as a trough with its axis at 7.6 kms a.s.l. extended along Long. 64° E to the north of Lat. 28° N on 4 August. A trough lay aloft with its axis at 5.8 kms a.s.l. extended along Long. 72° E to the north of Lat. 32° N on 7 & 8 and moved away northeastwards on 9
(*ii*)	*Trough in Westerlies*					
1.	Mid & upper tropospheric levels	16 - 26	Along Long.70° E to the north of Lat. 32° N (axis at 5.8 kms a.s.l.)	East	Along Long. 77° E to the north of Lat. 32° N (axis at 5.8 kms a.s.l.)	Moved away northeastwards on 27
(**D**)	*Other upper air cyclonic circulations*					
1.	Between Lower & Mid tropospheric levels	1 - 2	Southwest Rajasthan and neighbourhood	East	Southeast Rajasthan and neighbourhood	Became less marked on 3. It was associated with the low pressure area over Saurashtra & neighbourhood during 28 - 30 June
2.	Upto lower tropospheric levels	3	Sub-Himalayan West Bengal & Sikkim and neighbourhood	Stationary	*In-situ*	Became less marked on 4
3.	Between 3.1 & 5.8 kms a.s.l.	3	East Uttar Pradesh and neighbourhood	Do	Do	Became less marked on 4
4.	Do	3	Gujarat Region and neighbourhood	Do	Do	Became less marked on 4
5.	Upto mid tropospheric levels	4 - 5	Sub-Himalayan West Bengal & Sikkim and adjoining areas of Gangetic West Bengal and Bangla Desh	Do	Do	Became less marked on 6
6.	Between 2.1 & 7.6 kms a.s.l.	6 - 8	Northwest Bay of Bengal and neighbourhood	Do	*In-situ*	Became less marked on 9. It tilted southwestwards with height on 7 & 8
7.	Upto lower tropospheric levels	6	Haryana and neighbourhood	Do	Do	Became less marked on 7
8.	Upto mid tropospheric levels	6	Southwest Rajasthan and neighbourhood	Do	Do	Became less marked on 7
9.	Between 2.1 & 5.8 kms a.s.l.	8 - 12	Southwest Rajasthan and neighbourhood	Northeast	Northeast Rajasthan and neighbourhood	It became less marked on 13

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
10.	Upto lower tropospheric levels	13	Southwest Rajasthan and adjoining Pakistan	Stationary	*In-situ*	Became less marked on 14
11.	Upto mid tropospheric levels	10 - 11	South Pakistan and adjoining Kutch	East	Kutch and neighbourhood	It became less marked on 12
12.	Upto lower tropospheric levels	17 - 19	Kutch and adjoining southwest Rajasthan	Do	South Gujarat region and neighbourhood	It merged with the cyclonic circulation associated with the low pressure area over Kutch and neighbourhood on 20
13.	Do	20	Central parts of Rajasthan and neighbourhood	Stationary	*In-situ*	Became less marked on 21
14.	At lower levels	26 - 27	East Rajasthan and neighbourhood	East	Central parts of Rajasthan	It extended upto 7.6 kms a.s.l. when it was associated with the Depression I (1) It merged with the cyclonic circulation associated with the Heat Low on 28
15.	Between 4.5 & 5.8 kms a.s.l.	27	Gujarat Region and neighbourhood	Stationary	*In-situ*	Became less marked on 28
16.	At 5.8 kms a.s.l.	28 - 30	West central Bay of Bengal off Andhra Pradesh coast	Quasi-stationary	West central and adjoining southwest Bay of Bengal off south Andhra coast	Became less marked on 31
17.	Between 1.5 & 2.1 kms a.s.l.	29 - 30	Saurashtra & Kutch and neighbourhood	West	Kutch and adjoining south Pakistan	Became less marked on 31
18.	Between 0.9 & 5.8 kms a.s.l.	30	Northwest Bay of Bengal off west Bengal coast	Stationary	*In-situ*	Became less marked on 31
19.	Between lower & mid tropospheric levels	31 Jul - 1 Aug	Punjab and neighbourhood	East	Northern parts of Haryana and neighbourhood	Became less marked on 2 August
20.	Do	31 Jul - 2 Aug	Saurashtra & Kutch and neighbourhood	West	South Pakistan and neighbourhood	Became less marked on 3 August
(E) *North-south trough*						
1.	Upto lower tropospheric levels	31 Jul - 3 Aug	From Sub-Himalayan West Bengal & Sikkim to north Bay of Bengal	Stationary	*In-situ*	Became less marked on 4 August
(E) *East-West Shear Zone*						
1.	Between 5.8 & 7.6 kms a.s.l.	8 - 10	Along Lat. 15° N	South	Along Lat. 13°N	Became less marked on 11
2.	Between 3.1 & 7.6 kms a.s.l.	17 - 23	Along Lat. 21° N	South and then north	Along Lat. 23°N	Became un-important on 24
3.	At 5.8 kms a.s.l.	31 Jul	Along Lat. 23° N	Stationary	*In-situ*	Became less marked on 1 August

system during June formed as a low pressure area (28-30 June) over Saurashtra and adjoining northeast Arabian Sea and dissipated over Kutch and neighbourhood. The first low pressure area in July (7-8 July) formed over northern parts of Uttar Pradesh and neighbourhood and dissipated over northeastern parts of Uttar Pradesh and adjoining Bihar. The second system, a well-marked low pressure area (11-16 July) also formed over east Uttar Pradesh and neighbourhood but moved westwards and became less marked over south Pakistan and neighbourhood. The third system concentrated into a Depression (18-19 July) which formed over northwest and

TABLE 6

Details of the weather systems during August 2017

S. No.	System	Duration	Place of initial location	Direction of movement	Place of Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Well marked low/low pressure area*					
1.	Well marked low pressure area	18 - 21	Northwest Bay of Bengal and adjoining Odisha coast	Southwest - west - northwest	Southwest Madhya Pradesh and neighbourhood	It formed under the influence of a cyclonic circulation extending upto mid tropospheric levels over north Bay of Bengal and neighbourhood. It became well marked for one day on 20 and became less marked on 21. Associated cyclonic circulation extended up to upper tropospheric levels tilting southwards with height
2.	Do	27 Aug (1200 UTC) - 1 Sep	Northwest Bay of Bengal & adjoining coastal Odisha and west central Bay of Bengal	West	South Pakistan and neighbourhood	It formed under the influence of a cyclonic circulation over northwest Bay of Bengal off north Odisha-west Bengal coasts. It was well marked during 29 - 31 August. It became un-important on 2 September
(**B**)	*Western Disturbances /Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	Between 3.1 & 5.8 kms a.s.l.	8 - 10	Northeast Afghanistan and adjoining north Pakistan	Northeast	Eastern parts of Jammu & Kashmir and neighbourhood	Moved away northeastwards on 11
2.	Upto mid tropospheric levels	12 - 15	North Afghanistan	Do	North Pakistan and adjoining Jammu & Kashmir	It moved away east-northeastwards on 16. A trough aloft with its axis at 5.8 kms a.s.l. persisted during 13-15
3.	Do	16 - 20	Northeast Afghanistan and adjoining north Pakistan	Do	Eastern parts of Jammu & Kashmir and neighbourhood	Moved away northeastwards on 20 evening. A trough lay aloft on 17 & 18 and became less marked on 19
4.	Do	21 - 22	North Pakistan and neighbourhood	East-northeast	Southeastern parts of Jammu & Kashmir & neighbourhood	It moved away east northeastwards on 22nd evening
5.	Between 3.1 & 5.8 kms a.s.l.	22 - 28	Northeast Afghanistan and neighbourhood	Do	Jammu & Kashmir and neighbourhood	Moved away northeastwards on 28 evening. A trough with its axis at 7.6 kms a.s.l. lay aloft on during 23 - 28
6.	Between 3.1 & 5.8 kms a.s.l.	28 - 30	North Pakistan and neighbourhood	Do	North Pakistan and adjoining Jammu & Kashmir	Moved away northeastwards on 31. A trough with its axis at 7.6 kms a.s.l. lay aloft on 29 & 30
7.	At 3.1 kms a.s.l.	31Aug - 2 Sep	Do	Do	North Pakistan and adjoining Jammu & Kashmir	Moved away northeastwards on 3 Sept. A trough with its axis at 5.8 kms a.s.l. lay aloft during 31 August - 2 September
(**C**)	*Other upper air cyclonic circulations*					
1.	Between 2.1 & 5.8 kms a.s.l.	2 - 3	Northern parts of central Uttar Pradesh and neighbourhood	East	Northern parts of east Uttar Pradesh & adjoining Bihar and neighbourhood	Became less marked on 4
2.	At 3.1 kms a.s.l.	2	Southwest Bay of Bengal off north Tamil Nadu coast	Stationary	*In-situ*	Became less marked on 3
3.	Upto upper tropospheric levels	3 - 10	Northwest Bay of Bengal and neighbourhood	North then west - northwest	West Uttar Pradesh and neighbourhood	The cyclonic circulation tilted southwards with height. It became less marked on 11

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.	At 5.8 kms a.s.l.	4	Northeast Rajasthan and neighbourhood	Stationary	*In-situ*	Became less marked on 5
5.	Upto lower tropospheric levels	4	Sub - Himalayan West Bengal and neighbourhood	Do	Do	Became less marked on 5
6.	At 7.6 kms a.s.l.	4 - 5	North Karnataka coast and neighbourhood	South	South interior Karnataka and neighbourhood	Became less marked on 6
7.	Upto mid tropospheric levels	5 - 8	Kutch and adjoining areas of south Pakistan	North-northeast	Central Pakistan and neighbourhood	It merged with the cyclonic circulation associated with the Heat Low on 9
8.	Upto 1.5 kms a.s.l.	6	Southeast Uttar Pradesh and neighbourhood	Stationary	*In-situ*	Became less marked on 7
9.	Upto lower tropospheric levels	6 - 7	Central parts of Assam and neighbourhood	Do	Do	Became less marked on 8
10.	At 5.8 kms a.s.l.	7	North interior Karnataka and neighbourhood	Do	Do	Became less marked on 8
11.	Between lower & mid tropospheric levels	8 - 13	South Pakistan and adjoining Kutch	North	Central Pakistan and neighbourhood	It merged with the cyclonic circulation associated with the Heat Low on 14
12.	Between mid & upper tropospheric levels	8 - 14	Southeast Arabian Sea off south Karnataka-north Kerala coasts	Do	East central Arabian Sea off north Maharashtra coast	Became less marked on 15
13.	Between 3.1 & 5.8 kms a.s.l.	10 - 12	Madhya Maharashtra and neighbourhood	Northwest	Gujarat Region an neighbourhood	Became less marked on 13
14.	At 5.8 kms a.s.l.	11	Maldives - Lakshadweep area	Stationary	*In-situ*	Became less marked on 12
15.	Upto mid tropospheric levels	12 - 15	Eastern parts of Bihar and neighbourhood	West	Northeast Uttar Pradesh and neighbourhood	Became less marked on 16
16.	At lower levels	13 - 14	Coastal Tamil Nadu and neighbourhood	South	South coastal Tamil Nadu and neighbourhood	Became less marked on 15. Initially it lay as a feeble north-south trough extended upto 1.5 kms a.s.l. during 10-12
17.	Between 1.5 & 3.6 kms a.s.l.	13	Southwest Bay of Bengal off north Tamil Nadu - south Andhra Pradesh coasts	Stationary	*In-situ*	Became less marked on 14
18.	At 5.8 kms a.s.l.	14	Marathwada and neighbourhood	Do	Do	Became less marked on 15
19.	Between 3.6 & 5.8 kms a.s.l.	14	Lakshadweep area and neighbourhood	Do	Do	Became less marked on 15
20.	Between 3.1 & 5.8 kms a.s.l.	15 - 16	Northern parts of Bihar and neighbourhood	East	Northeast Bihar and neighbourhood	Became less marked on 17
21.	Between 1.5 & 2.1 kms a.s.l.	15	South Pakistan and adjoining Kutch	Stationary	*In-situ*	Became less marked on 16
22.	At 3.1 kms a.s.l.	16	West Assam and neighbourhood	Do	Do	Became less marked on 17
23.	Upto 0.9 km a.s.l.	18	Southeast Uttar Pradesh and neighbourhood	Do	Do	It merged with the monsoon trough on 19

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
24.	Between 1.5 & 2.1 kms a.s.l.	18	West Assam and neighbourhood	Do	Do	Became less marked on 19
25.	Upto upper tropospheric levels	20 - 26	Arakan coast and neighbourhood	North and then west	Northeast Madhya Pradesh and neighbourhood	It merged with the monsoon trough on 27
26.	Between 1.5 & 2.1 kms a.s.l.	20	South Pakistan and neighbourhood	Stationary	*In-situ*	Became less marked on 21
27.	Upto 1.5 kms a.s.l.	22	Southeast Bangla Desh and neighbourhood	Do	Do	It merged with the cyclonic circulation over northeast Bay of Bengal and neighbourhood on 23
28.	At 0.9 km a.s.l.	23 - 26	Northwest Rajasthan and neighbourhood	North	Western parts of Punjab and neighbourhood	It merged with the monsoon trough on 27
29.	Between 3.6 & 5.8 kms a.s.l.	23	West central Bay of Bengal and adjoining coastal Andhra Pradesh	Stationary	*In-situ*	It merged with the cyclonic circulation over north coastal Odisha and neighbourhood on 24
30.	Upto 2.1 kms a.s.l.	24	East Uttar Pradesh and neighbourhood	Do	Do	Became less marked on 25
31.	Upto 0.9 km a.s.l.	25	West central Bay of Bengal off north coastal Andhra Pradesh and neighbourhood	Do	Do	Became less marked on 26
32.	Upto 0.9 km a.s.l.	25	Northeast Assam & neighbourhood	Do	Do	Became less marked on 26
33.	Upto 4.5 kms a.s.l.	26	Eastern parts of Mizoram and Tripura	Do	Do	It merged with the cyclonic circulation over northwest Bay of Bengal off north Odisha-west Bengal coasts on 27
34.	Upto 0.9 km a.s.l.	26 - 27	West Uttar Pradesh and neighbourhood	West	West Uttar Pradesh and adjoining Haryana	Became less marked on 28
35.	Upto 1.5 kms a.s.l.	28	South Rajasthan and neighbourhood	Stationary	*In-situ*	It merged with the monsoon trough on 29
36.	Between 3.1 & 5.8 kms a.s.l.	31	Southeast Bangla Desh and neighbourhood	Do	Do	It merged with the north-south trough extended from north Bihar and neighbourhood to west central Bay of Bengal across Gangetic West Bengal and northwest Bay of Bengal on 1 September
(**D**)	*North-South trough/other trough*					
1.	At 0.9 km a.s.l.	8 - 9	From north Rajasthan to west central Bay of Bengal across north Madhya Pradesh, Chhattisgarh and north coastal Andhra Pradesh	Oscillatory	South Punjab to Gangetic West Bengal across south Uttar Pradesh and Jharkhand	Became less marked on 10
2.	Upto 1.5 kms a.s.l.	12	From cyclonic circulation over eastern parts of Bihar and neighbourhood to south Assam	Stationary	*In-situ*	Became less marked on 13
3.	Between 1.5 & 3.1 kms a.s.l.	13	From cyclonic circulation over east Bihar and adjoining Sub- Himalayan West Bengal to northwest Bay of Bengal across Gangetic West Bengal	Do	Do	Became less marked on 14

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4.	Upto lower levels	15 - 16	From Rayalaseema to south Tamil Nadu	Oscillatory	From Telangana to south coastal Tamil Nadu	Became less marked on 17
5.	At 0.9 km a.s.l.	24	From east Bihar to north coastal Andhra Pradesh across Jharkhand and interior Odisha	Stationary	*In-situ*	Became less marked on 25
6.	Upto mid tropospheric levels	31 Aug - 4 Sep	Sub- Himalayan West Bengal & Sikkim to north Odisha coast	Oscillatory	Eastern parts of Arunachal Pradesh to Mizoram	It moved away eastwards on 5 September
(**E**)	*East-West shear zone*					
1.	Between 3.1 & 4.5 kms a.s.l.	5	Along Lat. 21° N	Stationary	Along Lat. 21° N	Became less marked on 6
2.	At 5.8 kms a.s.l.	13	Along Lat. 8° N	Do	*In-situ*	Became less marked on 14
3.	Between mid & upper tropospheric levels	15 - 19	Along Lat. 10° N	North	Along Lat. 15° N	Became less marked on 20
4.	At 7.6 kms a.s.l.	23	Along Lat. 13° N	Stationary	*In-situ*	Became less marked on 24
5.	Between 5.8 & 7.6 kms a.s.l.	26 - 27	Along Lat. 15° N	South	Along Lat. 14° N	Became less marked on 28

adjoining west central Bay of Bengal and coastal areas of Odisha and dissipated over coastal Odisha and neighbourhood. This was followed by two very short lived low pressure areas on 20-21 July respectively over Kutch and neighbourhood and south Gujarat region and neighbourhood. The last system of July formed as a Land Depression (26-27 July) over northwest Jharkhand and neighbourhood and dissipated over southeast Uttar Pradesh and neighbourhood. Cyclogenesis during August and September remained very much subdued as a result of the overall weakening of the monsoon flow pattern over the Indian region. This is also reflected in the number of Low Pressure System (LPS) [low pressure areas and depressions combined] days, which shows 11 in June, 12 in July, 10 in August and 6 in September against a normal of 11, 14, 17 & 16 during the respective months. The total number of LPS days during the season had been only 39 as against the normal of 58. The two well-marked low pressure areas in August occurred during 18-21 August & 27th August - 1st September. However, both of them traversed across central India, the first one formed over northwest Bay of Bengal and neighbourhood and dissipated over Kutch & neighbourhood and the second one formed over southeast Odisha and neighbourhood and became less marked over south Pakistan. The only one system formed in September, a well-marked low pressure area (19-24 September) formed over northwest Bay of Bengal and neighbourhood and dissipated over west Uttar Pradesh and adjoining Uttarakhand.

The off-shore trough along different parts of the west coast persisted from 30th May - 23rd September except during 2nd June - 9th June, 19th June, 6th - 9th July, 24th July - 21st August, 23-28 August and 31st August - 15th September. It was quite feeble on 10th June, 18th June, 20th June, 30th June, 1-2 July, 5th July and 22nd September.

4. Extra Indian features

4.1. *Cross Equatorial Flow*

4.1.1. *Over the Arabian Sea*

The Cross Equatorial flow along the equatorial belt (equator to 5° N/ 5° S) over the Arabian Sea was Stronger than normal in June except for the 3nd week in which it was normal, stronger than normal in 1st & 3rd week and weaker than normal in 2nd week of July while close to normal in 4th week, Stronger than normal in 1st week, close to normal in 2nd & 4th week and weaker than normal in 3rd week during August and Stronger than normal in 1st, 2nd and 4th week while weaker than normal in 3rd week during September.

The surface winds over Arabian Sea to the north of 5° N were close to normal during June, close to normal in 1st, 2nd and 4th weeks of July but weaker than normal in 2nd week of July, stronger than normal in 1st week of August,

TABLE 7

Details of the weather systems during September 2017

S. No.	System	Duration	Place of initial location	Direction of movement	Place of Final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Well marked low/low pressure area*					
1.	Well marked Low pressure area	19 - 24	Northwest Bay of Bengal and neighbourhood	West-north-west	West Uttar Pradesh and neighbourhood	It formed under the influence of a cyclonic circulation extending between lower & mid tropospheric levels over northwest Bay of Bengal and adjoining coastal areas of Odisha and Gangetic West Bengal. It was well marked during 21 - 23. Became less marked on 24 evening. Associated cyclonic circulation extended upto upper tropospheric levels
(**B**)	*Western Disturbances /Eastward moving systems*					
(*i*)	*As a Trough in westerlies*					
1.	Mid & upper tropospheric levels	13-18	Along Long. 65° E to the north of Lat. 28° N (axis at 5.8 kms a.s.l.)	Northeast	Along Long. 72° E to the north of Lat. 26° N (axis at 5.8 kms a.s.l.)	It lay as an upper air cyclonic circulation extending between 3.1 & 5.8 kms a.s.l. with a trough aloft with its axis at 7.6 kms a.s.l. during 15 - 17. It moved away east - northeastwards on 19
2.	Between 3.1 & 3.6 kms a.s.l.	29	Along Long. 71° E to the north of Lat. 30° N (axis at 5.8 kms a.s.l.)	Do	Along Long. 72° E to the north of Lat. 35° N (axis at 5.8 kms a.s.l.)	The feeble trough lay as a cyclonic circulation extending between 3.1 & 3.6 kms a.s.l. over northeast Afghanistan and neighbourhood on 2 October and over eastern parts of Jammu & Kashmir and neighbourhood on 3 October. It moved away east-northeastwards on 4 October
(*ii*)	*As an upper air cyclonic circulation*					
1.	At 3.1 kms a.s.l.	3 -7	Northeast Afghanistan and adjoining Pakistan	Northeast	Northeast Jammu & Kashmir and neighbourhood	It moved away east-northeastwards on 8. A trough with its axis at 5.8 kms a.s.l. lay aloft on 6 & 7
2.	Between 3.1 & 5.8 kms a.s.l.	7 -10	North Pakistan and neighbourhood	East	North Pakistan and adjoining Jammu & Kashmir	It moved away east-northeastwards on 11. A trough with its axis at 7.6 kms a.s.l. lay aloft on 7 and became less marked on 8
3.	Between 3.1 & 3.6 kms a.s.l.	11 -13	Northeast Afghanistan and adjoining Pakistan	Northeast	Do	Moved away northeastwards on 14. Initially a trough with its axis at 5.8 kms a.s.l. lay aloft on 11 and as a trough between 3.1 & 5.8 kms a.s.l. along Long. 70° E to the north of Lat. 32° N on 12
4.	Do	19 -21	North Pakistan and neighbourhood	East	Eastern parts of Jammu & Kashmir and adjoining Himachal Pradesh	It lay at 3.1 kms a.s.l. on 21 & 22 and moved away east- northeastwards on 22
5.	Between 3.1 & 5.8 kms a.s.l.	19 - 24	West Afghanistan and neighbourhood	Northeast	Eastern parts of Afghanistan and neighbourhood	A trough lay aloft during 19 - 21. The cyclonic circulation lay as a trough with its axis at 5.8 kms a.s.l. extended along Long.65° E to the north of Lat. 25° N on 22; along Long. 70° E to the north of Lat. 25° N on 23; along Long.74° E to the north of Lat. 25° N on 24 and moved away east-northeastwards on 24 evening

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.	Between 3.1 & 5.8 kms a.s.l.	26 - 27	North Pakistan and neighbourhood	Northeast	Northeastern parts of Jammu & Kashmir and neighbourhood	Initially it lay as a trough in mid & upper tropospheric levels with its axis at 5.8 kms a.s.l. on 24 & 25. It moved away east-northeastwards on 27 evening
(*iii*)	*Other upper air cyclonic circulations*					
1.	Upto 1.5 kms a.s.l.	1-3	North Bihar and neighbourhood	East	Sub- Himalayan West Bengal and neighbourhood	It became less marked on 4
2.	Upto mid tropospheric levels	1 - 7	Southwest Bay of Bengal off south Sri Lanka coast	West - northwest	East central Arabian Sea and adjoining coastal Karnataka	It became less marked on 8
3.	Upto 1.5 kms a.s.l.	2	Punjab and neighbourhood	Stationary	*In-situ*	It became less marked on 3
4.	At 3.1 kms a.s.l.	3	South Rajasthan and adjoining Gujarat	Do	Do	It became less marked on 4
5.	Between 1.5 & 3.6 kms a.s.l.	6 - 7	Southwest Bay of Bengal and adjoining coastal areas of Tamil Nadu	North and then northwest	North interior Karnataka and neighbourhood	It became less marked on 8
6.	Between 1.5 & 5.8 kms a.s.l.	6 - 7	Northeast Rajasthan and adjoining coastal areas of Tamil Nadu	Stationary	*In-situ*	It became less marked on 8
7.	Between 1.5 & 3.1 kms a.s.l.	8	West Uttar Pradesh and neighbourhood	Do	Do	It became less marked on 9
8.	Do	8 - 9	Southwest Rajasthan and neighbourhood	Do	Do	It became less marked on 10
9.	At 1.5 kms a.s.l.	9	East Arabian Sea off Karnataka coast	Do	Do	It became less marked on 10
10.	Between lower & mid tropospheric levels	10 - 14	East Bangla Desh and neighbourhood	Northwest	North Bangla Desh and neighbourhood	Became less marked on 15
11.	Upto mid tropospheric levels	11 - 16	Kerala and neighbourhood	North north-west	East central Arabian Sea and adjoining Karnataka	Became less marked on 17
12.	Between 0.9 & 3.6 kms a.s.l.	11 - 15	Southwest Rajasthan and adjoining south Pakistan	East	Southwest Madhya Pradesh and neighbourhood	It became less marked on 16
13.	At 1.5 kms a.s.l.	11	West Madhya Pradesh and neighbourhood	Stationary	*In-situ*	Became less marked on 12
14.	Upto mid tropospheric levels	12-27	Gangetic West Bengal and adjoining Bangla Desh	Oscillatory	East Uttar Pradesh and adjoining Bihar	It was associated with the well-marked low pressure area during 19 - 24 (E) and extended upto 7.6 kms a.s.l tilting southwards with height. It became less marked on 28
15.	Upto 0.9 km a.s.l.	16	Nagaland- Manipur-Mizoram-Tripura and neighbourhood	Stationary	*In-situ*	Became less marked on 17
16.	Between 2.1 & 5.8 kms a.s.l.	16 - 17	Konkan & Goa and neighbourhood	Northeast	Southwest Madhya Pradesh and neighbourhood	Became less marked on 18
17.	Between 1.5 & 3.1 kms a.s.l.	16	Vidarbha and neighbourhood	Stationary	*In-situ*	Became less marked on 17

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
18.	Upto 1.5 kms a.s.l.	16	Gujarat Region and neighbourhood	Stationary	*In-situ*	Became less marked on 17
19	Upto 3.1 kms a.s.l.	17 - 18	Central Uttar Pradesh and neighbourhood	South	Northeast Madhya Pradesh and neighbourhood	Became less marked on 19
20.	Between 1.5 & 7.6 kms a.s.l.	17 - 21	Saurashtra and neighbourhood	Southeast - northwest	South Gujarat Region and neighbourhood	Became less marked on 22. It tilted southwards with height
21.	Upto 0.9 km a.s.l.	18	Gangetic west Bengal and adjoining Jharkhand	Stationary	*In-situ*	Became less marked on 19
22.	Between 5.8 & 7.6 kms a.s.l.	19 - 20	South Bangla Desh and neighbourhood	North	Sub - Himalayan West Bengal & Sikkim and neighbourhood	It lay at 3.1 kms a.s.l. on 20 and became less marked on 21
23.	Upto 0.9 km a.s.l.	21 - 23	Northwest Rajasthan and neighbourhood	Northeast	Northwest Rajasthan and adjoining Punjab	It extended upto 5.8 kms a.s.l. on 21. It became less marked on 24
24.	Do	21	Assam & Meghalaya and neighbourhood	Stationary	*In-situ*	Became less marked on 22
25.	Upto 7.6 kms a.s.l.	21 Sep - 4 Oct	Gulf of Siam and neighbourhood	Northwest- west-northwest- north-northeast	Bangla Desh and neighbourhood	It lay embedded in the east-west shear zone during 26 - 29. It tilted southwards with height during 27 - 29. It became less marked on 5 October
26.	At 7.6 kms a.s.l.	22	Southeast Bay of Bengal and neighbourhood	Stationary	*In-situ*	Became less marked on 23
27.	Between 1.5 & 3.1 kms a.s.l.	24	Northwest Bay of Bengal and neighbourhood	Do	Do	Became less marked on 25
28.	Upto 0.9 km a.s.l.	25-27	East Assam & neighbourhood	East	Nagaland and adjoining Manipur	It became less marked on 28
29.	Between 3.1 & 3.6 kms a.s.l.	25	South Madhya Maharashtra and neighbourhood	Stationary	*In-situ*	Became less marked on 26
30.	Upto 5.8 kms a.s.l.	26 Sep - 1 Oct	North Andaman Sea	Northwest	Northern parts of Gangetic West Bengal and neighbourhood	It became less marked on 2 Oct. It lay embedded in the cyclonic circulation over west central Bay of Bengal off Andhra Pradesh coast on 26
31.	Upto 0.9 km a.s.l.	26	Northwest Bay of Bengal and neighbourhood	Stationary	*In-situ*	Became less marked on 27
32.	At 1.5 kms a.s.l.	27	North interior Tamil Nadu and neighbourhood	Do	Do	It became less marked on 28
33.	Between 3.1 & 7.6 kms a.s.l.	28 Sep - 1 Oct	North Kerala coast and neighbourhood	East and then northwest	East central Arabian Sea off Karnataka coast	It became less marked on 2 Oct. It tilted southwards with height during 29 September - 1 October
34.	Upto 3.1 kms a.s.l.	28 Sep - 1 Oct	East Uttar Pradesh and neighbourhood	West then southeast	Southeast Uttar Pradesh and neighbourhood	It became less marked on 2 October
35.	Upto 0.9 km a.s.l.	28-29	Northern parts of Telangana and neighbourhood	Stationary	*In-situ*	It merged with the trough extended from south Odisha and neighbourhood to coastal Karnataka across Telangana, Rayalaseema and south interior Karnataka on 30
(C)	*Other Troughs/North-south trough*					
1.	Upto 0.9 km a.s.l.	2-3	Rayalaseema to south Tamil Nadu	Stationary	*In-situ*	It became less marked on 4

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 3.1 kms a.s.l.	3 - 4	From south Madhya Maharashtra to north interior Karnataka	Oscillatory	From south Madhya Maharashtra to Lakshadweep area across coastal Karnataka	It became less marked on 5
3.	Upto 0.9 km a.s.l.	4 - 7	South Chhattisgarh to Rayalaseema	Do	North Chhattisgarh to south Tamil Nadu across Telangana and Rayalaseema	It became less marked on 8
4.	Upto 3.1 kms a.s.l.	5 - 6	From east Bihar to north Bay of Bengal across Gangetic West Bengal	Stationary	*In-situ*	It extended between 2.1 & 3.6 kms a.s.l. on 6 and became less marked on 7
5.	At 1.5 kms a.s.l.	7	From east Bihar to interior Odisha across Gangetic West Bengal	Do	Do	It became less marked on 8
6.	Upto 0.9 km a.s.l.	8 - 10	From Madhya Maharashtra to south Tamil Nadu across Karnataka	Oscillatory	From Madhya Maharashtra to north interior Karnataka	It became less marked on 11. A cyclonic circulation between 1.5 & 3.6 kms a.s.l. lay embedded over Madhya Maharashtra and neighbourhood on 8 and became less marked on 9
7.	Between 1.5 & 3.1 kms a.s.l.	9 - 10	From sub-Himalayan West Bengal to north Bay of Bengal across Bangla Desh	Do	From sub-Himalayan West Bengal to interior Odisha across east Jharkhand	It became less marked on 11
8.	Upto 1.5 kms a.s.l.	11	From east Bihar to north Odisha across east Jharkhand	Stationary	*In-situ*	It became less marked on 12
9.	Upto 0.9 km a.s.l.	11 - 13	From the cyclonic circulation over Kerala and neighbourhood to Madhya Maharashtra across interior Karnataka	West	From the cyclonic circulation over Lakshadweep and neighbourhood to south Gujarat	It became less marked on 14
10.	Upto 1.5 kms a.s.l.	20 - 22	From cyclonic circulation over north Chhattisgarh and neighbourhood associated with low pressure area to Konkan across Vidarbha and Marathwada	Do	From Uttarakhand to south Konkan across west Uttar Pradesh, west Madhya Pradesh and north Madhya Maharashtra	It lay at 3.1 kms a.s.l. on 21 & 22 and became less marked on 23
11.	Between 0.9 km & 1.5 kms a.s.l.	27 Sep - 1 Oct	From the cyclonic circulation over north coastal Andhra Pradesh to north Kerala across Rayalaseema and south interior Karnataka	Oscillatory	From the cyclonic circulation over south Odisha and neighbourhood to coastal Karnataka	It became less marked on 1 October
12.	At 0.9 km a.s.l.	28	From the cyclonic circulation over northern parts of Telangana and neighbourhood to south Konkan across Marathwada and Madhya Maharashtra	Stationary	*In-situ*	It became less marked on 29
(**D**)	*East-West shear zone/Wind discontinuity*					
1.	Between 2.1 & 7.6 kms a.s.l.	5 - 10	Along Lat. 5° N	North	Along Lat. 11° N	Became less marked on 11
2.	At 3.1 kms a.s.l.	14 - 15	Along Lat. 22 ° N	Stationary	Along Lat. 22° N	Became less marked on 16

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3.	Between 4.5 & 7.6 kms a.s.l.	17	Along Lat. 14 ° N	North	Along Lat. 18 ° N	Became less marked on 18
4.	At 3.1 kms a.s.l.	24	From cyclonic circulation over Gulf of Martaban and adjoining north Andaman Sea to Lakshadweep across south Bay of Bengal, north Tamil Nadu and Kerala	Stationary	*In-situ*	It became less marked on 25.Initially it lay as a trough at 3.1 kms a.s.l. extended from the cyclonic circulation over Gulf of Martaban and adjoining north Andaman Sea to Lakshadweep across south Bay of Bengal, Rayalaseema and Kerala on 23
5.	Between 1.5 & 7.6 kms a.s.l.	25 - 29	Along Lat. 12 ° N	North	Along Lat. 15 ° N	It tilted southwards with height. It became less marked on 30

weaker than normal in 2nd and 3rd week of August but in 4th week when it was close to normal. It was Stronger than normal during September.

4.1.2. *Over the Bay of Bengal*

The Cross Equatorial flow along the equatorial belt (equator to 5° N/ 5° S) over the Bay of Bengal was Stronger than normal during June; Stronger than normal in July except in 2nd week in which it was close to normal. Stronger than normal in August except for the 3rd week in which it was close to normal and Stronger than normal in 1st and 2nd week of September while close to normal in the 3rd and 4th week .

The surface winds over the Bay of Bengal to the north of 5° N were close to normal in June; Stronger than normal in the 1st week, close to normal in 2nd & 3rd week of July while weaker in the 4th week of July, was close to normal in August except in 3rd week in which it was stronger than normal and was Stronger than normal in September.

4.2. *Systems in West Pacific Ocean/South China Sea*

There were, in all, 19 low pressure systems (reaching the intensity of Tropical depression and above) in the northwest Pacific Ocean / South China Sea during June - September 2017. No low pressure system (Tropical Depression, Tropical Storm or Typhoon) was reported in Southern Hemisphere during June - September 2017.

4.3. *Troughs in mid & upper westerlies affecting the Indian region to the south of 30° N*

The number of troughs in mid & upper tropospheric westerlies affecting the Indian region which penetrated south of 30° N is 3 in June, 1 each in July and August and 3 in September at 500 hPa and 4 in June, 2 in July, 3 in August and 5 in September at 300 hPa.

4.4. *Systems in southern hemisphere*

4.4.1. *Tropical storms/depressions*

No low pressure system (TD, TS or Typhoon) was reported in Southern hemisphere during June - September 2017.

4.4.2. *Mascarene High*

The Mascarene HIGH with its mean position at 34.2° S/70.3° E was strengthened by 6.4 hPa during the monsoon period June to September 2017. It was above normal by 8.6, 3.9, 8.0, 4.9 hPa during the months of June, July, August and September 2017 respectively.

5. Semi-permanent systems

5.1. *Heat low*

Heat low was established in it near normal position during the last week of May. It was mostly seen in its near normal position all through the season and started gradually filling up from first week of September. It became less marked in the last week of September.

5.2. *Axis of Monsoon trough*

A heat trough was seen at mean sea level and at times in the lower tropospheric wind field along the Indo-Gangetic Plains from the 3rd week of May. With the southwest monsoon covering the entire country, this trough got established as the monsoon trough south of its normal position on 19th July.

The monsoon trough remained to the south of its normal position upto July end except for a couple of days when its eastern part shifted to north of its normal position. On 30th July, the eastern part of the trough was split in two parts for a day, of which one was to the north of its normal position and the other in its near normal position. Thereafter, the trough became inactive as it shifted to north of its normal position and lay close to the foothills of Himalayas on 3rd and 4th August. It shifted to its normal position with the western part remaining to its north of normal position during 5-9 August. On 10th August two branches of trough was seen to the north of its normal position which then shifted close to the foothills during 11-13 August. The western part of the monsoon trough remained close to the foot hills of the Himalayas during 14-17 August with the eastern part shifting towards the normal position. Thereafter, the trough was seen in its normal to near normal position during 18-23 August. The eastern end of the trough was seen south of its normal position and western end in normal position during 24-26 August and subsequently upto 31st August, it was seen to the south of its normal position. In the month of September, the monsoon trough was seen to the north of its normal position for most of the days of first half of the month except during 3-6 and 9-10 September when it was close to the foothills of the Himalayas. In the second half, either of the end (west/ east) was seen oscillating north-south and then to the south of its normal position. Towards the end of the month, its western end shifted close to the foothills of Himalayas and east end in its normal position. It became less marked on 27th September.

5.3. *Tibetan Anticyclone/High*

This year, the Tibetan anticyclone was seen southeast and east southeast of its normal position during most part of the June month. It got established in its normal position on 27th of June. It was seen close to its normal position 27th and 28th June. It was either west of its normal position or close to its normal position for the first half of July. Later it shifted to west northwest of its normal position in latter half of July and first 3rd week of August. It shifted back to its normal position on 23rd August. It later shifted to east northeast of its normal position during the last week of August and most parts of September. The last week of September saw it shifting east of its normal position after oscillating between west and east of its normal in its previous weeks. It became unimportant in the second week of October.

5.4. *Sub-Tropical Westerly Jet (STWJ)*

The STWJ started shifting northwards from the second week of May. Srinagar reported 91 knots wind (at 211 hPa) at 0000 UTC on 21st May. Subsequently, the

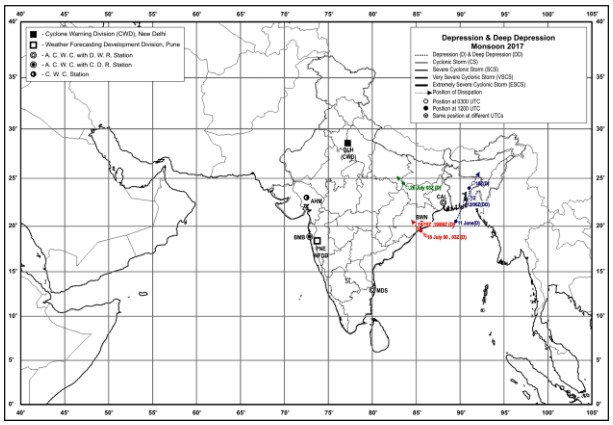

Fig. 8. Tracks of the intense low pressure systems during SW Monsoon 2017

core of STWJ shifted to the north of the Himalayas. However, it made occasional re-appearances along the latitude of Srinagar. Mid-August , it once again shifted southwards with 76 knots westerly wind reported over Srinagar at 172 hPa on 13th August and reappeared on 3rd September with 61 kts at 263 hPa (0000 UTC) over Srinagar.

5.5. *Tropical Easterly Jet (TEJ)*

The TEJ got established over the southern tip of Peninsular India by 19th May with Chennai reporting easterlies of 65 kts at 103 hPa level. A wide latitudinal spread of the easterly jet speed winds was observed during July, August and September (first fortnight) while during June and second fortnight of September; the stations over the Peninsular India only reported jet wind speeds. The highest wind speed of 124 kts at 107 hPa was reported at Bengaluru on 10th July.

Apart from Thiruvananthapuram, Chennai, Amini Divi, Minicoy, Panjim, Mumbai and Port Blair, Jet speed winds were also reported over Ahmedabad, Bhubaneswar, Mangaluru, Hyderabad, Jagdalpur, Jharsuguda, Kochi, Kolkata, Nagpur, Pune, Ranchi, Aurangabad, Bhopal, Raipur, Machilipatnam, Patiala, Karaikal and Visakhapatnam on several days during the season.

6. Disastrous weather events and damage during Monsoon months

6.1. *June*

According to media reports due to heavy rain 30 lives were lost in Maharashtra, 2 in Gujarat, 25 in Bihar, 2 in Tripura, 3 in Odisha and 16 in Madhya Pradesh Also 32

cattle and eight houses were damaged due to lightning in Maharashtra. There were quite a number of casualties due to flood too. Two were killed and five went missing and thousands were rendered homeless and a lot of property and agricultural land was damaged in Imphal, Manipur. Four people were washed away in Kohima and standing crops and vegetables were damaged. Roads, electric poles were damaged and communication was affected and electric supply were disrupted in Agartala, Tripura. Four districts of Assam were affected by flood and landslides. Five people were killed in sudden landslides at different locations of North Tripura. Eight died and seven injured in a wall collapse in Baddi and Solan in Himachal Pradesh due to the squally wind that hit the region. Two people died in Thunderstorms in Hyderabad, Telangana. Rain related mishaps claimed 8 lives in south Bengal.

6.2. *July*

Heavy rains led to floods and landslides in parts of the country. According to media reports 44 lives were lost in Assam while nearly 17 lakh people were affected due to the floods. 3 deer died due to drowning in the northern range of Kaziranga National Park. There were blocked highways and quite a few roads and bridges were damaged. A crop area of 1,40,83,42 hectares was damaged in Assam. Trains were cancelled in Odisha due to floods. 1 person died by drowning in Maharashtra. 73 people were killed in Assam and 2 washed away in floods in Himachal Pradesh. Death toll due to floods rose to 95 in Assam, Manipur and Arunachal Pradesh. 3 people were swept away in Diu, Gujarat and 6 died in Kolkata due to floods. 80 people died in Guwahati, Assam. 39 died and 27 lakh people were affected along with standing crops of nearly 4 lakh hectares damaged due to floods in West Bengal. 8 people died and 11 injured, houses schools and shops were damaged as a cloud burst (as reported by the Media) hit the mountains in Doda and Kishtwar districts of Jammu and Kashmir.

Heavy rains in many parts of India led to landslides. Some of the National highways had been cut off from the rest of the city due to landslides like the National Highway connecting Kashmir valley with the rest of the country, highways in Assam, Nagaland, Guwahati, blocked highway in Nasik, Maharashtra, damaged highway in Nagaland, Kangra, Himachal Pradesh. Jammu Srinagar highway was blocked and Amarnath highway was closed due to landslides. Highway traffic was disrupted in Manipur and it was cut off by road from the rest of the country after the Bailey bridge collapsed. Many lives were lost due to heavy landslides in different parts of the country. One life was lost and 5 were injured at Vaishnodevi, Jammmu. One person died and 1 injured in Agartala, Tripura. Two lives were lost and 3.54 lakh people were affected in 13 districts of the state in Guwahati, Assam.

According to media reports many people lost their lives and were injured too due to lightning in various parts of India. 10 people died and 5 injured in Madhya Pradesh, 23 died and 11 injured in Bihar, 3 died and 1 injured in Jharkhand, 34 people lost their lives in a span of 36 hours in Odisha, 2 women died and 1 injured in Supaul, Bihar and 3 died in Ongole, Andhra Pradesh.

6.3. *August*

According to media reports many people died and property was damaged due to floods and rains in various parts of India. 304 people died and about 1.38 crore people were affected in 18 districts of Bihar. 102 people died and 60 thousand people were affected in West Bengal. 15 people were killed and 31.59 lakh people were affected in Assam, 3 died and 13 injured in Tripura, 33 people died in Uttar Pradesh, 140 animals found dead in Kaziranga national Park in Assam. Death toll was 482 in Bihar, 101 in UP and 156 in Assam. 6 people died due to rains in Marathwada. Due to heavy rainfall 12 people died and rail, air and road transports were affected in Mumbai. 3 people died in Vijayapura in Karnataka.

48 people died and many injured in Himachal Pradesh due to landslides. Landslides in North east blocked the NH-39 which is the lifeline of Mizoram. 7 buildings and a church collapsed in Aizwal.

Deaths and injury were caused due to lightning in various parts of India. 3 died and 3 injured in Barabanki, Uttar Pradesh, 2 killed and 4 injured in Jamui,Bihar, 6 killed and 3 injured in Andhra Pradesh, 1 killed and 1 injured in Telangana, 1 killed and 1 injured in Uttarakhand due to lightning.

6.4. *September*

According to media reports heavy rainfall caused loss of life and property in many parts of India. 25 people died, 40,000 people and 78,677 hectares of agricultural land affected in Assam and Manipur. 6 people killed and 2 injured in Sikkim. Standing crops on hundreds of acres of land were destroyed in Raichur and Kalburgi district in Karnataka and Aligarh in Maharashtra. Due to rainfall 4 people died in Tamilnadu and 8 in Maharashtra.

Lightning claimed the lives of 3 each in Maharashtra, Madhya Pradesh, Telangana and 4 people were killed and 3 were injured in Yadgir, Karnataka.

Acknowledgment

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

Appendix

Definitions of the terms given in *'Italics'*

Snowfall

Light Snowfall - 10.4 cm or less

Moderate Snowfall - 10.5 to 64.4 cm

Heavy - 64.5 cm to 115.5 cm

Very heavy - 115.6 to 204.4 cm

Extremely heavy - ≥204.5 cm

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 from + 19 % to – 19 %

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

Large Deficient - Percentage departure from normal rainfall is from – 60 % to –99%

No rain - *-100%*

Monsoon activity

Active - Average rainfall of a sub-division is more than 1½ to 4 times the normal with minimum 5 cms along the west coast and 3 cms elsewhere in at least two stations in the sub-division

Vigorous - Average rainfall of a sub-division is more than 4 times or more than the normal with minimum 7 cm along the west coast and 5 cm elsewhere in at least two stations in the sub-division