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Weather in India

MONSOON SEASON (June - September 2023)†

1. Introduction

The rainfall over the country as a whole during the monsoon season (June-September) 2023 was 95% of its long period average (LPA), thus categorized as normal monsoon. However, the monthly rainfall of August for the homogenous regions of Central India (53% of LPA) and South Peninsula (40% of LPA) and for the country (64% of LPA) was the lowest recorded since 1901. For June with 93% of its LPA, the precipitation was normal, while it was excess at 113% of its LPA for July and September. Total fourteen low-pressure systems formed during monsoon season of 2023, out of which one intensified to an Extremely Severe Cyclonic Storm (ESCS), "BIPARJOY", one Deep Depression and Depression each against the normal frequency of 4-6 Depressions. The monsoon arrival over Kerala was delayed by 7 days from its normal date and also the further advance was late over most parts of the country outside northwest India where it arrived earlier to its normal date, covering the entire country on 2 July, 6 days ahead of its normal date. The withdrawal of southwest monsoon began on 25 September (normal date 17 September) and the monsoon withdrew from the entire country on 16 October against its normal date of 15 October. El Nino conditions prevailed during the Southwest monsoon season which along with unfavorable Madden Julian Oscillation (MJO) and a neutral Indian Ocean Dipole (IOD) substantially reduced the precipitation during August. The presence of positive IOD during September aided in reviving the monsoon and bringing down the seasonal rainfall deficiency.

2. Various aspects of southwest Monsoon - 2023

2.1. *Onset and advance*

Fig.1 shows the isochrones and Table I shows the details of advance of monsoon over the country. In view of strengthening of south westerlies in the lower tropospheric levels, fairly widespread to widespread rainfall activity and persistent cloudiness over the area, Southwest monsoon advanced over the parts of Andaman Sea on 19 May (normal date 22 May), it set in over Kerala on 8 June, 7 days later than its normal date. This delay reflected in the

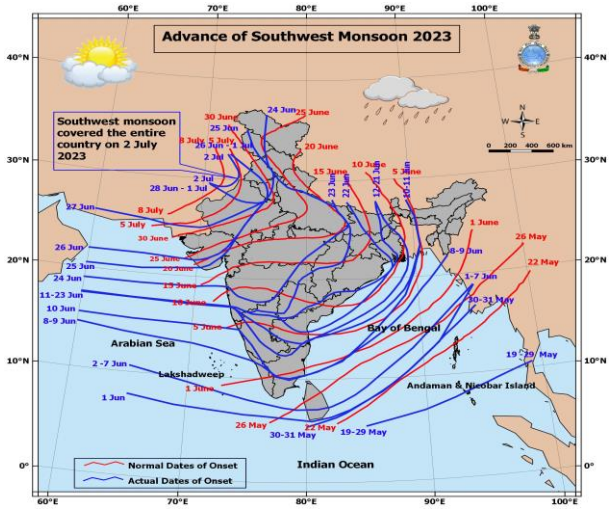

Fig. 1. Isochrones of advance of SW monsoon 2023

advance of the monsoon current with it covering South Peninsula with a lag of 5-14 days, Northeast India with about 5 days delay and east India 3 to 7 days later than their respective normal dates. There was a hiatus in the advance from 12 to 19 June, with the genesis and movement of Extremely Severe Cyclonic Storm (ESCS) "BIPARJOY" over the east central Arabian Sea during 6 to 19 June and its slow, nearly northward movement before moving northeastwards and crossing Saurashtra & Kutch and adjoining Pakistan on 15 June. This led to subdued rainfall over most parts of South Peninsula, Central and East India. After the dissipation of this system, the monsoon regime was reestablished and during the period 22-28 June, the monsoon advanced rapidly over Northwest India and Central India and by 24 June the monsoon current had covered major South Peninsula, East & Northeast India, some parts of Central India and Northwest India covering Mumbai city where the delay was of 14 days. Favorable synoptic situations on 25 June resulted in rainfall over major parts of the country resulting in very rapid advance of the monsoon, not only covering the regions where monsoon was late, but it also arrived earlier than normal dates over some parts of Northwest India reaching two days earlier than normal date over Delhi. After this, the monsoon current covered most regions of the country, apart from small areas in northern Rajasthan and eastern

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

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TABLE 1

Advance of southwest Monsoon 2023

S. No.	Date	Southwest monsoon advanced over	Northern limit of monsoon passed through
1.	19 May	Some parts of southeast Bay of Bengal, Nicobar Islands and south Andaman sea	Lat. 5° N/Long. 85° E, Lat. 6.5° N/Long. 90° E, Nancowry and Lat. 10° N/Long. 98° E
2.	30 May	Some parts of southwest Bay of Bengal, some more parts of southeast Bay of Bengal, entire Andaman, Nicobar Islands, Andaman Sea and some parts of eastcentral Bay of Bengal	Lat. 5° N/ Long. 80° E, Lat. 6.5° N/ Long. 83° E, Lat. 10° N/ Long. 88° E, Lat. 14° N/ Long. 92° E and Lat. 17° N/ Long. 95° E.
3.	01 Jun	Some parts of south Arabian Sea, Maldives, Comorin area, some more parts of south Bay of Bengal and eastcentral Bay of Bengal	Lat. 7° N/Long. 65° E, Lat. 6.5° N/ Long. 70° E, Lat. 6° N/ Long. 75° E, Lat. 6° N/ Long. 81° E, Lat. 8° N/ Long. 85° E, Lat. 10° N/ Long. 88° E, Lat. 14° N/ Long. 92° E and Lat. 19° N/ Long. 95° E.
4	02 Jun	Some more parts of south Arabian Sea and Maldives area, some parts of Lakshadweep area, entire Comorin area, some more parts of south Bay of Bengal and east central Bay of Bengal	Lat. 10° N/Long. 65° E, Lat. 9° N/ Long. 70° E, Minicoy, Lat. 7° N/ Long. 81° E, Lat. 11° N/ Long. 87° E, Lat. 14° N/ Long. 90° E, Lat. 17° N/ Long. 93° E and Lat. 19° N/ Long. 95° E.
5.	08 Jun	Remaining parts of south Arabian Sea and some parts of central Arabian Sea, entire Lakshadweep area, most parts of Kerala, most parts of south Tamil Nadu, remaining parts of Comorin area, Gulf of Mannar and some more parts of southwest, central and northeast Bay of Bengal	Lat. 13.5° N/ Long. 55° E, Lat. 14.0° N/ Long. 60° E, Lat. 13.5° N/ Long. 65° E, Lat. 13° N/ Long. 70° E, Cannur, Kodaikanal, Adirampattinam, Lat. 12.0° N/ Long. 83.0° E, Lat. 16.0° N/ Long. 88.0° E, Lat. 18.5° N/ Long. 90.0° E, Lat. 22.0° N/ Long. 93.0° E.
6.	10 Jun	Some more parts of central Arabian Sea, remaining parts of Kerala, some parts of Karnataka, some more parts of southwest Bay of Bengal, entire parts of eastcentral Bay of Bengal, most parts of northeast Bay of Bengal, some parts of northwest Bay of Bengal and most parts of northeastern States	lat. 14.5° N/ Long. 55° E, Lat. 15.0° N/ Long. 60° E, Lat. 15° N/ Long. 65° E, Lat. 15° N/ Long. 70° E, Karwar, Mercara, Kodaikanal, Adirampattinam, Lat. 12.0° N/ Long. 83.0° E, Lat. 16.0° N/ Long. 87.0° E, Lat. 21° N/ Long. 90.0° E, Lat. 23.5° N / Long. 90.5° E, Dhubri, Lat. 28° N/ Long. 89° E
7	11 Jun	Some more parts of central Arabian Sea, some more parts of Karnataka, Goa, some parts of Konkan, most parts of Tamil Nadu and Puducherry, some parts of Andhra Pradesh, entire southwest and some more parts of westcentral Bay of Bengal, some more parts of northwest Bay of Bengal and remaining parts of northeast Bay of Bengal	Lat. 16.5° N/Long. 55° E, Lat. 17.0° N/Long.60° E, Lat. 17° N/Long. 65° E, Lat. 17° N/ Long. 70° E, Ratnagiri, Shivamogga, Hassan, Dharmapuri, Shriharikota, Lat. 15.0° N/ Long. 83.0° E, 18.0° N/87.0° E, 21° N/90.0° E, 23.5° N /90.5° E, Dhubri, 28° N/89° E
8.	12 Jun	Some more parts of Karnataka, Konkan, remaining parts of Tamil Nadu, some more parts of Andhra Pradesh, some more parts of northwest Bay of Bengal, most parts of Sub Himalayan West Bengal, Sikkim and some parts of Bihar	Lat. 16.5° N/ Long. 55° E, Lat. 17.0° N/ Long. 60° E, Lat. 17° N/ Long. 65° E, Lat. 17° N/ Long. 70° E, Ratnagiri, Koppal, Puttaparthi, Shriharikota, Lat. 15.0° N/ Long. 83.0° E, Lat. 18.0° N/Long. 87.0° E, Lat. 22° N/Long. 89.5° E, Malda and Forbesganj, Lat. 28° N/Long. 86° E.
9.	19 Jun	Some more parts of Karnataka, Andhra Pradesh, westcentral and northwest Bay of Bengal; some parts of Gangetic West Bengal and Jharkhand; some more parts of Bihar and remaining parts of Sub Himalayan West Bengal and Sikkim today, the 19th June.	Lat. 16.5° N/ Long. 55° E, Lat. 17.0° N/ Long. 60° E, Lat. 17° N/ Long. 65° E, Lat. 17° N/ Long. 70° E, Ratnagiri, Raichur, Kavali, Lat. 18° N/ Long. 85° E, Lat. 20.5° N/Long. 87.5° E, Canning, Sriniketan, Dumka, Lat. 26.5° N/ Long. 87° E and Lat. 28° N/ Long. 86° E
10	22 Jun	Some parts of Telangana, remaining parts of Andhra Pradesh, some parts of Odisha, remaining parts of westcentral Bay of Bengal, some more parts northwest Bay of Bengal, some more parts of Gangetic West Bengal, Jharkhand and Bihar	Lat. 16.5° N/ Long. 55° E, Lat. 17.0° N/ Long. 60° E, Lat. 17° N/ Long. 65° E, Lat. 17° N/ Long. 70° E, Ratnagiri, Raichur, Khammam, Malkangiri, Paralakhemundi, Lat. 21.5° N/Long. 87.5° E, Haldia, Bokaro, Patna, Raxaul and Lat. 28° N/ Long. 84° E
11	23 Jun	Some more parts of Karnataka, Telangana, remaining parts of Andhra Pradesh, some parts of Vidarbha, Chhattisgarh, remaining parts of northwest Bay of Bengal, remaining parts of Odisha, Gangetic West Bengal, some more parts of Jharkhand, Bihar and some parts of east Uttar Pradesh	Lat. 16.5° N/ Long. 55° E, Lat. 17.0° N/ Long. 60° E, Lat. 17° N/ Long. 65° E, Lat. 17° N/ Long. 70° E, Ratnagiri, Bijapur, Nizamabad, Durg, Daltonganj, Buxar, Siddharthnagar and Lat. 28° N/ Long. 82.5° E.
12	24 Jun	Some more parts of central Arabian Sea, some more parts of Maharashtra, remaining parts of Karnataka, Telangana and Chhattisgarh, some parts of east Madhya Pradesh, some more parts of Uttar Pradesh, most parts of Uttarakhand and Himachal Pradesh, some parts of Haryana, Jammu-Kashmir and Ladakh.	Lat. 17.5° N/ Long. 55° E, Lat. 18.0° N/ Long. 60° E, Lat. 18° N/ Long. 65° E, Lat. 18.5° N/ Long. 71° E, Alibag, Solapur, Udgir, Nagpur, Mandla, Sonbhadra, Buxar, Lat. 26° N/ Long. 83.7° E, Siddharthnagar, Pantnagar, Bijnor, Yamunanagar, Una and Dras.

TABLE 1 (*Contd.*)

S. No.	Date	Southwest monsoon advanced over	Northern limit of monsoon passed through
13	25 Jun	Remaining parts of central Arabian sea, some parts of north Arabian sea, remaining parts of Maharashtra including Mumbai, Madhya Pradesh and Uttar Pradesh, Delhi, some parts of Gujarat, Rajasthan and Haryana, remaining parts of Uttarakhand and most parts of Himachal Pradesh and some more parts of Jammu, Kashmir and Ladakh	Lat. 20.5° N/ Long. 55° E, Lat. 20.5° N/ Long. 60° E, Lat. 20.5° N/ Long. 65° E, Veraval, Vallabh Vidyanagar, Udaipur, Narnaul, Ambala, Katra and Lat. 35.0° N/ Long. 74° E.
14	26 Jun	Some more parts of north Arabian Sea, some more parts of Gujarat, Rajasthan, Haryana and Punjab, remaining parts of Jammu, Kashmir and Ladakh	Lat. 22.0° N/ Long. 55° E, Lat. 22.0° N/ Long. 60° E, Lat. 22.0° N/ Long. 65° E, Porbandar, Ahmedabad, Udaipur, Narnaul, Firozpur and Lat. 32.5° N/ Long. 72.5° E.
15	27 Jun	Most parts of north Arabian Sea, remaining parts of Gujarat and some more parts of Rajasthan.	Lat. 26.0° N/ Long. 55° E, Lat. 26.0° N/ Long. 65° E, Lat. 25.0° N/ Long. 70° E, Jodhpur, Sikar, Narnaul, Firozpur and Lat. 32.5° N/Long. 72.5° E
16	28 Jun	Remaining parts of north Arabian Sea and some more parts of Rajasthan today, the 28th June.	Lat. 29.4° N/ Long. 70.7° E, Bikaner, Narnaul, Firozpur and Lat. 32.5° N/ Long. 72.5° E.
17	02 Jul	Remaining parts of Rajasthan, Haryana and Punjab	The Southwest Monsoon has covered the entire country on 2nd July 2023

TABLE 2

Withdrawal of southwest Monsoon 2023

S. No	Date	Southwest monsoon withdrew from	Withdrawal line passed through
1.	25 Sept	Parts of southwest Rajasthan.	28.3° N/72.0° E, Nokhra, Jodpur, Barmer, 25.7° N/70.3° E.
2.	30 Sept	Some parts of Jammu-Kashmir and Ladakh, Himachal Pradesh and Uttarakhand; entire Punjab and Haryana-Chandigarh-Delhi; some parts of west Uttar Pradesh, west Madhya Pradesh and east Rajasthan and some more parts of est Rajasthan	Gulmarg, Dharamshala, Pantnagar, Etawah, Morena, Sawai Madhopur, Jodhpur, Barmer and 25.7° N/70.3° E.
3.	3 Oct	Some more parts of Uttarakhand, west Uttar Pradesh, west Madhya Pradesh; remaining parts of Rajasthan, and some parts of Gujarat state	Gulmarg, Dharamshala, Mukteshwar, Pilibhit, Orai, Ashoknagar, Indore, Baroda and Porbandar.
4.	6 Oct	Remaining parts of Jammu, Kashmir and Ladakh, Gilgit, Baltistan, Muzaffarabad, Himachal Pradesh, Uttarakhand, west Uttar Pradesh, west Madhya Pradesh, Gujarat State; some parts of east Uttar Pradesh, east Madhya Pradesh, Vidarbha, Marathwada, Madhya Maharashtra and Konkan; entire north Arabian Sea and some parts of central Arabian Sea.	Lat. 28.6° N/ Long. 80.6° E, Lucknow, Satna, Nagpur, Parbhani, Pune, Alibag and Lat. 18.9° N/ Long. 70.0° E.
5.	9 Oct	Remaining parts of east Uttar Pradesh, east Madhya Pradesh; some parts of Bihar, Jharkhand, Chhattisgarh, Telangana and north Interior Karnataka; most parts of Maharashtra and some more parts of central Arabian sea today, the 09 October, 2023.	Lat. 27.0° N/Long. 85.0° E, Raxaul, Daltonganj, Kanker, Ramagundam, Bijapur, Vengurla and Lat. 16.0° N/Long. 70.0° E.
6	13 Oct	Most parts of Bihar; remaining parts of Jharkhand; some parts of Sub Himalayan West Bengal; entire Gangetic West Bengal and Odisha; remaining parts of Chhattisgarh; some parts of coastal Andhra Pradesh; most parts of Telangana; some more parts of north Interior Karnataka.	Forbesganj, Malda, Lat. 24.0° N/Long. 89.0° E, Lat. 20.0° N/Long. 89.0° E, Vishakhapatnam, Nalgonda, Raichur, Vengurla and Lat. 16.0° N/Long. 70.0° E.
7	16 Oct		Monsoon withdrew from the entire country on 16 October 2023.

TABLE 3

Rainfall figures (mm) for each month and season as a whole (June-September 2023)

S. No.	Meteorological Sub-divisions	June			July			August			September			Season		
		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	Andaman & Nicobar Islands	494.5	417.5	18%	492.5	387.1	27%	477.1	397.6	20%	1064.7	429.5	148%	2528.8	1631.7	55%
2	Arunachal Pradesh	382.8	454.7	-16%	492.0	529.2	-7%	438.1	343.2	28%	179.0	348.0	-49%	1491.9	1675.1	-11%
3	Assam & Meghalaya	555.4	486.6	14%	354.0	552.3	-36%	377.4	394.7	-4%	181.0	328.6	-45%	1467.8	1762.2	-17%
4	Nagaland–Manipur–Mizoram–Tripura	254.1	353.2	-28%	235.1	354.2	-34%	301.6	326.0	-7%	172.4	268.3	-36%	963.3	1301.7	-26%
5	Sub–Himalayan West Bengal & Sikkim	551.3	455.9	21%	563.0	586.3	-4%	556.0	459.1	21%	350.7	388.2	-10%	2021.0	1889.5	7%
6	Gangetic West Bengal	176.4	247.9	-29%	184.4	344.8	-47%	289.7	308.3	-6%	258.5	265.8	-3%	909.0	1166.8	-22%
7	Odisha	163.7	209.3	-22%	319.7	341.4	-6%	299.9	363.8	-18%	332.1	235.7	41%	1115.4	1150.2	-3%
8	Jharkhand	106.5	189.5	-44%	167.5	318.7	-47%	228.3	290.7	-21%	249.0	224.0	11%	751.3	1022.9	-27%
9	Bihar	85.0	163.3	-48%	178.2	340.5	-48%	306.5	271.9	13%	190.9	216.5	-12%	760.6	992.2	-23%
10	East Uttar Pradesh	60.3	108.3	-44%	189.2	276.9	-32%	203.9	240.6	-15%	115.8	173.4	-33%	569.8	799.2	-29%
11	West Uttar Pradesh	102.3	78.6	30%	268.2	240.3	12%	191.5	228.3	-16%	134.1	124.8	7%	696.2	672.0	4%
12	Uttarakhand	150.5	176.8	-15%	547.1	417.8	31%	353.9	385.7	-8%	151.8	182.4	-17%	1203.3	1162.7	3%
13	Haryana, Chandigarh & Delhi	82.8	55.3	50%	237.9	150.5	58%	59.9	147.7	-59%	45.0	77.2	-42%	425.7	430.7	-1%
14	Punjab	65.8	54.5	21%	231.3	161.4	43%	54.9	146.2	-62%	64.4	77.7	-17%	416.4	439.8	-5%
15	Himachal Pradesh	120.7	101.1	19%	447.5	255.9	75%	246.4	256.8	-4%	67.1	120.6	-44%	881.8	734.4	20%
16	Jammu & Kashmir	110.7	75.9	46%	261.1	192.6	36%	131.0	184.9	-29%	78.5	95.7	-18%	570.7	549.1	4%
17	West Rajasthan	152.3	39.4	287%	191.5	107.8	78%	7.9	95.5	-92%	50.0	40.9	22%	401.7	283.6	42%
18	East Rajasthan	162.7	74.7	118%	274.8	228.6	20%	59.8	231.5	-74%	125.4	91.8	37%	622.7	626.6	-1%
19	West Madhya Pradesh	119.1	117.8	1%	353.3	297.7	19%	121.8	312.8	-61%	312.9	149.0	110%	907.1	877.3	3%
20	East Madhya Pradesh	188.3	148.4	27%	257.5	342.7	-25%	305.9	362.3	-16%	246.9	190.0	30%	998.6	1043.4	-4%
21	Gujarat Region	173.7	133.3	30%	449.8	340.3	32%	39.7	307.0	-87%	245.2	146.9	67%	908.4	927.5	-2%
22	Saurashtra & Kutch	277.0	93.6	196%	407.5	196.3	108%	6.1	156.8	-96%	105.0	93.2	13%	795.7	539.9	47%
23	Konkan & Goa	503.2	701.5	-28%	1827.4	1053.5	73%	325.6	741.7	-56%	526.0	374.1	41%	3182.1	2870.8	11%
24	Madhya Maharashtra	77.8	157.7	-51%	302.3	229.5	32%	71.8	201.2	-64%	202.3	159.0	27%	654.3	747.4	-12%
25	Marathwada	41.6	134.7	-69%	287.5	170.4	69%	47.0	176.8	-73%	193.7	160.9	20%	569.7	642.8	-11%
26	Vidarbha	89.7	175.4	-49%	442.5	309.3	43%	144.7	297.1	-51%	245.6	155.5	58%	922.6	937.3	-2%
27	Chhattisgarh	167.0	188.0	-11%	331.8	369.0	-10%	240.5	364.2	-34%	320.9	211.0	52%	1060.1	1132.2	-6%
28	Coastal Andhra Pradesh and Yanam	69.2	109.5	-37%	236.3	158.6	49%	90.4	170.3	-47%	188.4	163.0	16%	584.2	601.4	-3%
29	Telangana	65.2	131.4	-50%	481.3	218.5	120%	79.9	226.1	-65%	220.4	158.8	39%	846.9	734.8	15%
30	Rayalaseema	52.8	72.3	-27%	87.8	92.1	-5%	48.5	107.3	-55%	167.9	136.9	23%	357.0	408.6	-13%
31	Tamil Nadu, Puducherry and Karaikal	53.5	50.7	6%	65.1	69.0	-6%	87.4	90.1	-3%	148.2	118.6	25%	354.3	328.4	8%
32	Coastal Karnataka	435.5	863.6	-50%	1609.3	1088.9	48%	222.9	821.3	-73%	432.1	320.1	35%	2699.8	3093.9	-13%
33	North Interior Karnataka	47.6	105.3	-55%	219.8	116.5	89%	33.5	119.4	-72%	128.6	139.6	-8%	429.5	480.8	-11%
34	South interior Karnataka	65.6	149.7	-56%	258.9	200.6	29%	41.8	179.5	-77%	123.6	148.6	-17%	489.8	678.4	-28%
35	Kerala and Mahe	259.4	648.3	-60%	591.7	653.5	-9%	60.0	445.1	-87%	415.5	271.8	53%	1326.6	2018.7	-34%
36	Lakshadweep	226.9	335.6	-32%	291.9	289.3	1%	85.4	232.0	-63%	268.5	169.7	58%	872.7	1026.6	-15%

Haryana by 28 June. The monsoon covered the entire country on 2 July, 6 days earlier than its normal date of 8 July.

2.2. *Monthly rainfall distribution*

Monthly and Seasonal Rainfall for the country as a whole is depicted in Figs. 2 to 6. During the month of June, the precipitation over the country was normal but on the negative side, with rainfall of 93% of Long Period Average (LPA). Rainfall over Northwest India was above normal at 150% of LPA (Long Period Average) due to the influence of the Extremely Severe Cyclonic Storm (ESCS), "BIPARJOY". The monthly rainfall over the homogeneous region of South Peninsular India was 87.9 mm which was 55% of the respective L.P.A. and was the lowest for the region since 1901, the previous lowest rainfall value being 90.7 mm (56% of LPA) observed in the year 1976. Rainfall over the sub division of Kerala & Mahe was the third lowest (259.4 mm) since 1901, the other two lowest rainfall years being in 1976 (196.4 mm) and 1962 (244.9 mm).

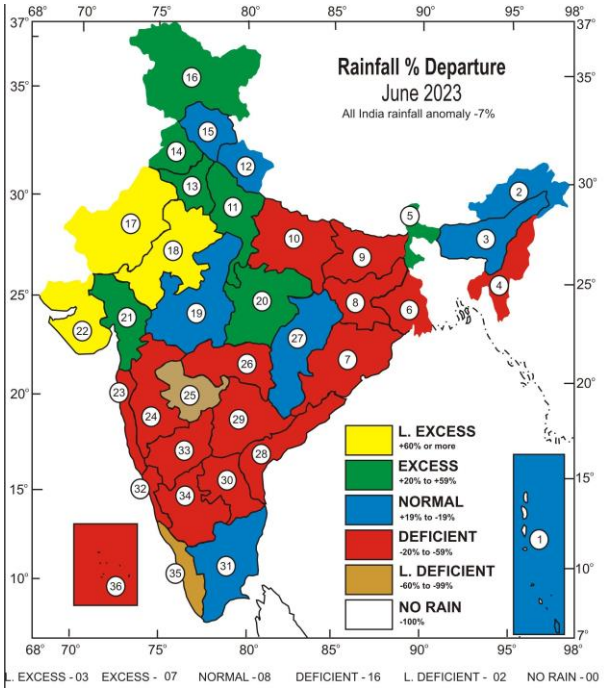


Fig. 2. Rainfall for the month of June 2023 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	18	**7**	-22	**13**	50	**19**	1	**25**	-69	**31**	6
2	-16	**8**	-44	**14**	21	**20**	27	**26**	-49	**32**	-50
3	14	**9**	-48	**15**	19	**21**	30	**27**	-11	**33**	-55
4	-28	**10**	-44	**16**	46	**22**	196	**28**	-37	**34**	-56
5	21	**11**	30	**17**	287	**23**	-28	**29**	-50	**35**	-60
6	-29	**12**	-15	**18**	118	**24**	-51	**30**	-27	**36**	-32

During June 2023 an ESCS, "BIPARJOY" (6-19 June) formed over the Arabian Sea. It was one of the cyclones with the longest duration over the North Indian Ocean with a total life period of 13 days and 3 hours, against the average life period of the very severe cyclonic storm category during monsoon season over the Arabian Sea being 6 days and 3 hours based on the data during 1990-2013. After landfall, the system maintained its intensity of cyclone up to 24 hours. The remnant of this system continued as a well-marked low-pressure area/low pressure area and moved slowly from central parts of east Rajasthan to central parts of Uttar Pradesh across northwest Madhya Pradesh during 20-25 June and helped in advancing the southwest monsoon up to Northwest India. This system caused heavy to extremely heavy rainfall over Gujarat region and Saurashtra and Kutch on 13 and during 15 to 18 June, over Rajasthan during 16 to 20 June and heavy to very heavy rainfall over Madhya Pradesh during 19 to 21 June. Besides this ESCS, two well marked low pressure areas formed over Bay of Bengal during 9-11 June and 25-30 June. Development and persistence of the Off-Shore trough along the west coast of India and cyclonic circulation at middle atmospheric level over northeast Arabian Sea off Gujarat coast, also enhanced rainfall along west coast and Gujarat during the last week of the month.

Some of the stations received record 24-hour rainfall during June 2023. A list of stations is given below with their previous record and date

Station	24 Hour record rainfall in June 2022 (mm)#	Date	Previous rainfall record (mm)	Date	State
ANGUL	170.0	26	161.2	15-06-1990	Odisha
NAJIBABAD	205.0	25	93.5	12-06-1984	Uttar Pradesh
SRIGANG ANAGAR	109.0	26	99.1	14-06-1938	Rajasthan
ERINPURA/ JAWAI DAM	239.0	19	78.3	25-06-1977	Rajasthan
NARSING-HPUR	218.0	28	217.6	27-06-1977	Madhya Pradesh
MAHUVA	225.0	30	179.6	30-06-1959	Gujarat
OKHA	228.1	17	190	30-06-1980	Gujarat
UDGIR	66.0	25	65.4	18-06-2012	Maharashta

Source: IMD Climate Summary for the month of June 2023

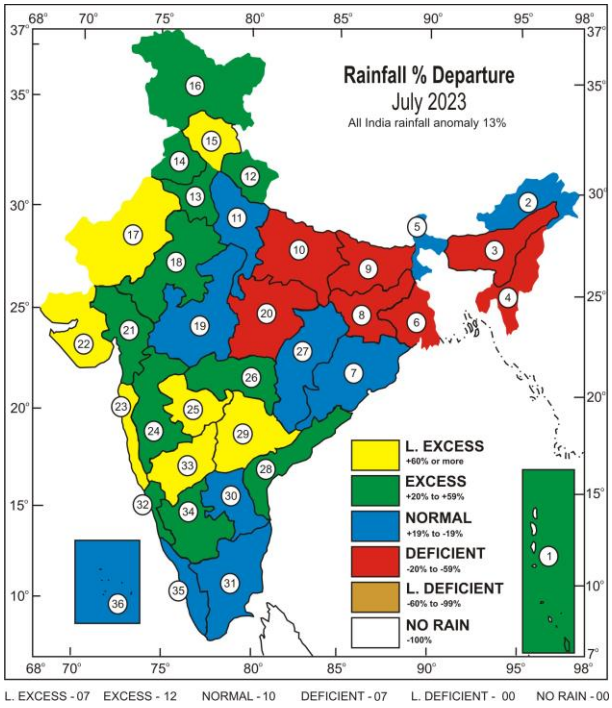


Fig. 3. Rainfall for the month of July 2023 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	27	**7**	-6	**13**	58	**19**	19	**25**	69	**31**	-6
2	-7	**8**	-47	**14**	43	**20**	-25	**26**	43	**32**	48
3	-36	**9**	-48	**15**	75	**21**	32	**27**	-10	**33**	89
4	-34	**10**	-32	**16**	36	**22**	108	**28**	49	**34**	29
5	-4	**11**	12	**17**	78	**23**	73	**29**	120	**35**	-9
6	-47	**12**	31	**18**	20	**24**	32	**30**	-5	**36**	1

During the month of July, the country recorded 113% of the respective L.P.A. with the homogeneous regions of Central India, Northwest India, and South Peninsula receiving excess rainfall of 122%, 125% and 144% of LPA respectively. The homogenous region of East & Northeast India recorded 290.2 mm rainfall which was 68% of LPA, it was the fourth lowest since 1901. Prior lowest rainfall years were 2022 (234.8 mm), 1903 (249.5 mm) and 1973 (284.3 mm). Rainfall over the homogeneous region of South peninsular India (295.5 mm) was eighth highest since 1901 after the years 1961 (344 mm), 2022 (327.5 mm), 1959 (322.1 mm), 1988 (305.7 mm), 1989 (301.8 mm), 1924 (301 mm) and 1903 (300.4 mm). The Monsoon Trough was south of its normal position throughout the month except for the last few days of the month due to continuous formation and west-northwestward movement of Low-Pressure systems and their remnants from northwest Bay of Bengal

A low pressure area over southwest Rajasthan and neighbourhood, a deep trough associated with a western disturbance, the influence of an off-shore trough from south Gujarat coast to north Kerala coast, convergence of strong southerlies /south westerlies from Bay of Bengal over Northeast India and the passage of the eastern end of the monsoon trough across the region, cyclonic circulations in the lower tropospheric levels and enhanced moisture incursion, together resulted in the weekly rainfall during the second week of the month to be 134% of L.P.A. bringing the cumulative weekly rainfall on the weekend 12 July to a positive departure for the first time since the season began. The Southwest Monsoon was vigorous over Jammu-Kashmir & Ladakh, Uttarakhand, Himachal Pradesh, Punjab, west Rajasthan, east Rajasthan, Saurashtra & Kutch, Marathwada, coastal Karnataka and Kerala & Mahe subdivisions for 1-3 days during this period. The devastation caused by these rains were unprecedented especially over the northwest region of the country. During the last week of July, under the influence of a Well Marked Low Pressure area (WMLP) and its movement from West central and adjoining Northwest Bay of Bengal to south Odisha and adjoining north Andhra Pradesh and neighbourhood with the associated cyclonic circulation extending up to 7.6 km above m.s.l., exceptionally heavy rainfall over Telangana was reported with stations such as Laxmidevipeta of Mulugu district reporting 65 cm, Chityal reporting 62 cm and Regonda reporting 47 cm from the district Jayashankar Bhupalpally in Warangal, on 27 July. Presence of a cyclonic circulation over northwest Madhya Pradesh and neighbourhood, another over west Rajasthan and neighbourhood, a trough in mid tropospheric westerlies, presence of an east-west shear zone along Latitude 18° N tilting southwards with height and an active Monsoon Trough south of its normal position, all collectively caused heavy to very heavy rainfall with isolated extremely heavy rainfall over West Rajasthan, West Uttar Pradesh, Gujarat Region, Chhattisgarh, Konkan & Goa, Madhya Maharashtra and Coastal Andhra Pradesh.

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

Station	24-Hour Record rainfall in July 2023 (mm)#	Date	Previous rainfall Record (mm)	Date	State
Ambala	224.1	9	211.7	16-7-2001	Haryana
Delhi Ridge	134.5	9	124	11-7-2003	Haryana
Chandigarh	302.2	9	262	18-7-2000	Chandigarh
Bilaspur Sadar	130.0	9	103.2	26-7-2012	Himachal Pradesh
Manali	131.3	9	100	13-7-1993	Himachal Pradesh

Pahalgam	73.3	8	71.2	27-7-1987	Jammu Kashmir
Leh	17.6	9	17.4	14-7-1980	Jammu Kashmir
Katra	315.4	19	292.4	31-7-2019	Jammu Kashmir
Bhind	120.0	27	79	6-7-1970	Madhya Pradesh
Bhupalpalle	238.4	27	140.5	24-7-1989	Telangana
Hasanparthy	289.6	27	227.8	13-7-1903	Telangana
Jayapura	128.6	25	104.9	18-7-1988	Karnataka
Kanjirappally	161.0	5	128.8	9-7-2001	Kerala

Source: IMD Climate Summary for the month of July 2023

By the end of July, the rainfall departure over the country was at four per cent above the normal. The deficiency of June was compensated by the excess July rainfall, but with a drier than normal August (64% of L.P.A.). While the cumulative seasonal rainfall deficit was - 9% of LPA at the end of August, the monthly rainfall over the country was 162.9 mm, which is 36% less than its LPA *i.e*. 254.9 mm based on data 1971-2020. It was the lowest since 1901 against previous record of 191.2 mm in 2005. The precipitation over 22 sub divisions amounting to 63% area of the country was deficient or large deficient, 11 sub divisions reported normal precipitation while 3 sub divisions reported excess rainfall. No sub division reported large excess rainfall. The monthly precipitation over homogeneous regions of Central India was 165.1 mm (53% of L.P.A.) and homogeneous region of South Peninsular India was 76.4 mm (40% of L.P.A.) was the lowest since 1901. The previous lowest rainfall over Central India was 172.8 mm in 1905 and 89.4 mm over South Peninsula in 1968. Rainfall over the homogeneous region of Northwest India (123.9 mm) was the eighth lowest since 1901 after 1993 (92.3 mm), 2005 (100.7 mm), 1920 (103.4 mm), 1979 (106.9 mm), 1939 (112.6 mm), 1905 (114.5 mm) and 2009 (120 mm).

The Mascarene HIGH was mostly to the southeast of its normal position (30° S and 50° E) during August. The Low-level Jet and the cross-equatorial flow over Arabian Sea were significantly weaker than their respective normal. The Tibetan HIGH was to the northwest of its normal position. The Heat Low lay to the west of its normal position and the lowest isobaric pressure value was 992 hPa. The Monsoon Trough at mean sea level lay to the north of its normal position or along the foot hills of Himalayas on most of the days during the month. A total of two low pressure systems (one Deep Depression (DD) and a Low - Pressure area (LP)) formed over Bay of Bengal

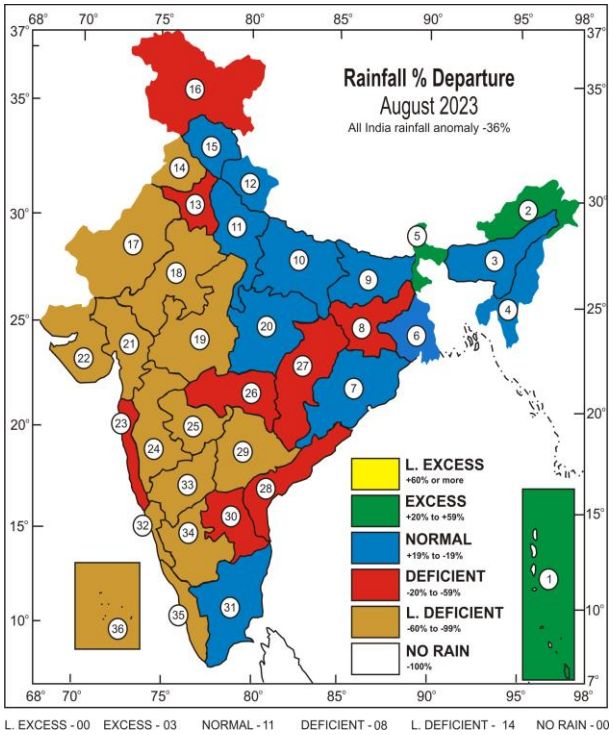


Fig. 4. Rainfall for the month of August 2023 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	20	**7**	-18	**13**	-59	**19**	-61	**25**	-73	**31**	-3
2	28	**8**	-21	**14**	-62	**20**	-16	**26**	-51	**32**	-73
3	-4	**9**	13	**15**	-4	**21**	-87	**27**	-34	**33**	-72
4	-7	**10**	-15	**16**	-29	**22**	-96	**28**	-47	**34**	-77
5	21	**11**	-16	**17**	-92	**23**	-56	**29**	-65	**35**	-87
6	-6	**12**	-8	**18**	-74	**24**	-64	**30**	-55	**36**	-63

against normal of five low pressure systems that form during this month, with a duration of nine Low pressure system days against normal of 16.3 days observed in the month. Since no remnant of low pressure from the Pacific Ocean reached the Bay of Bengal (as they usually do), fewer number of systems was formed in the month. The off-shore trough, off the west coast was absent, hence the rainfall activity over west coast of India and over Gujarat were highly subdued during the month. El Nino conditions were observed over the Pacific Ocean. The positive phase of the Indian Ocean Dipole (IOD), a favourable factor for the Indian summer monsoon, reached the threshold of a positive value only at the end of August. The Madden Julian Oscillation (MJO) lay in Phase 8 and Phase 1 and hence it was unfavourable and weak. All these factors individually were adverse for the rains and in conjunction were worse and this resulted in the large deficiency in the month of August.

During August, a total of two low pressure systems formed, (a Deep Depression and one Low Pressure area, 17-20 August) over Bay of Bengal. The formation and west-northward movement of the Deep Depression from northeast Bay of Bengal to Jharkhand caused extremely heavy rainfall at isolated places over Odisha and Heavy to very heavy rainfall at isolated places over Jharkhand and East Madhya Pradesh and Chhattisgarh on 1 August and exceptionally heavy rainfall over Odisha with stations of Boudhgarh and Jujumura reporting 39 cm and 36 cm respectively on 2 August. It also caused Heavy to very heavy rainfall at isolated places over Chhattisgarh and Madhya Pradesh. The Deep Depression weakened into a low pressure area and became less marked on 6 August. Weak monsoon conditions prevailed over most of the parts of India from 7 to 18 August which was mainly observed over plains of Northwest India, Central India, and South Peninsula region. The Monsoon Trough at mean sea level shifted southwards with the formation of a Low Pressure Area over Northwest Bay of Bengal and neighbourhood in the evening of 17 August. This system gradually moved from Northwest Bay of Bengal and adjoining areas of West Bengal-north Odisha coasts to central parts of north Madhya Pradesh by 20 August. It became less marked on 21 August morning, but its remnant cyclonic circulation moved northwards towards west Uttar Pradesh during 21-23 August.

Formation of a low pressure area over northwest and adjoining westcentral Bay of Bengal off south Odisha-north Andhra Pradesh coasts, its west-northwestwards movement and its remnant over south interior Odisha and neighbourhood caused isolated heavy to very heavy rainfall over east central India and adjoining peninsular India during 4-6 September Absence of mid tropospheric circulations over Gujarat and neighbourhood and off shore trough along the west coast of India resulted in the rainfall remaining subdued over west central India and West peninsular region, during most days in the month. A total of 5 Western Disturbances affected weather over north India but most of them were seen to the north of 30º N.

With the western end of the monsoon trough to the north of its normal position or running close to the foot hills of the Himalayas, its interaction with the western disturbances supported by enhanced moisture incursion caused fairly widespread to widespread rainfall /thunderstorms over the states of Himachal Pradesh and Uttarakhand. This led to floods and landslides causing huge devastation of lives and property in the month.

During September, the monthly rainfall for all India was 113% of L.P.A., three subdivisions recorded large excess, 15 normal and 6 deficient, no subdivision recorded large deficient or no rain, thus wetter than normal September helped in reducing the seasonal rainfall deficit. due to the formation and movement of consecutive low-pressure systems and cyclonic circulations associated with them along the monsoon trough from northwest Bay of Bengal towards central and western regions of India, active monsoon conditions prevailed over most parts of Central India and Northwest India from the second week of the month. As a result of these systems, exceptionally heavy rainfall was recorded over southwest Madhya Pradesh (Bhimpur - 45 cm) on 16th over southwest Madhya Pradesh (Kathiwada - 34 cm) and southeast Rajasthan (Bagidora - 37 cm) on 17th. Isolated heavy to very heavy rainfall with isolated extremely heavy rainfall was also reported mainly over Odisha, Chhattisgarh, Vidarbha, east Madhya Pradesh, Rajasthan and Gujarat. During the last week, formation and movement of two low pressure systems, a Depression over east central Arabian Sea off south Konkan-Goa coasts and a well-marked Low-Pressure Area over northwest Bay of Bengal caused heavy to very heavy rainfall over west coast as well as over east central and adjoining parts of East and Northeast India, respectively.

The positive Indian Ocean Dipole (IOD) and Madden Julian Oscillation (MJO) in Phase 3 and 4 were favourable and countered the El Nino effects which prevailed over the equatorial Pacific Ocean in September.

The table below shows stations receiving 24-hour record rainfall and corresponding previous record.

S. No.	Station	24-Hour record rainfall in Sep 2023 (Mm)#	Date	Previous rainfall record (mm)	Date of previous record rainfall	State
1.	Sabour	187.0	22	162.5	28-9-1995	Bihar
2.	Supaul	217.4	24	167	27-9-1975	Bihar
3.	Malanjkhand	166.6	15	140.3	11-9-1992	Madhya Pradesh
4.	Dhar	301.3	17	161.4	8-9-2010	Madhya Pradesh
5.	Mandvi	64.0	7	61	14-9-1961	Gujarat
6.	Bilaspur	135.6	15	83.8	19-9-2008	Chhattisgarh
7.	Durg	170.4	23	130.4	15-9-1983	Chhattisgarh
8.	Rajnandgaon	110.0	15	103	5-9-1994	Chhattisgarh

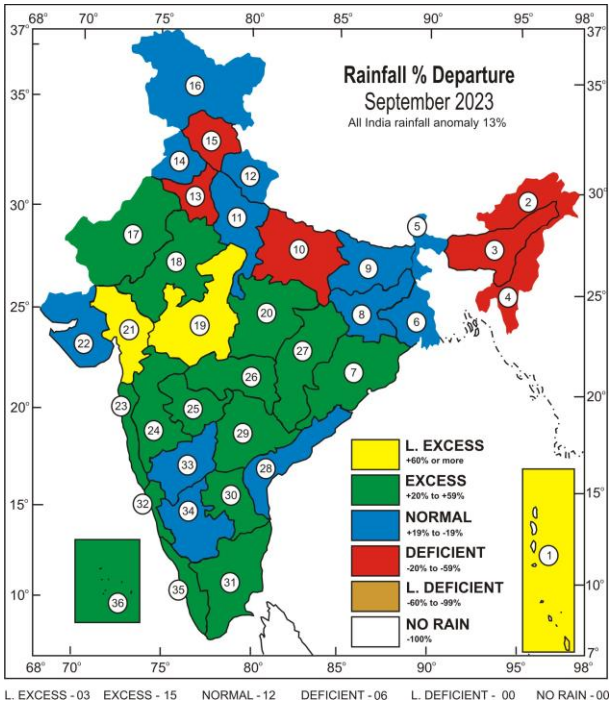


Fig. 5. Rainfall for the month of September 2023 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	148	**7**	41	**13**	-42	**19**	110	**25**	20	**31**	25
2	-49	**8**	11	**14**	-17	**20**	30	**26**	58	**32**	35
3	-45	**9**	-12	**15**	-44	**21**	67	**27**	52	**33**	-8
4	-36	**10**	-33	**16**	-18	**22**	13	**28**	16	**34**	-17
5	-10	**11**	7	**17**	22	**23**	41	**29**	39	**35**	53
6	-3	**12**	-17	**18**	37	**24**	27	**30**	23	**36**	58

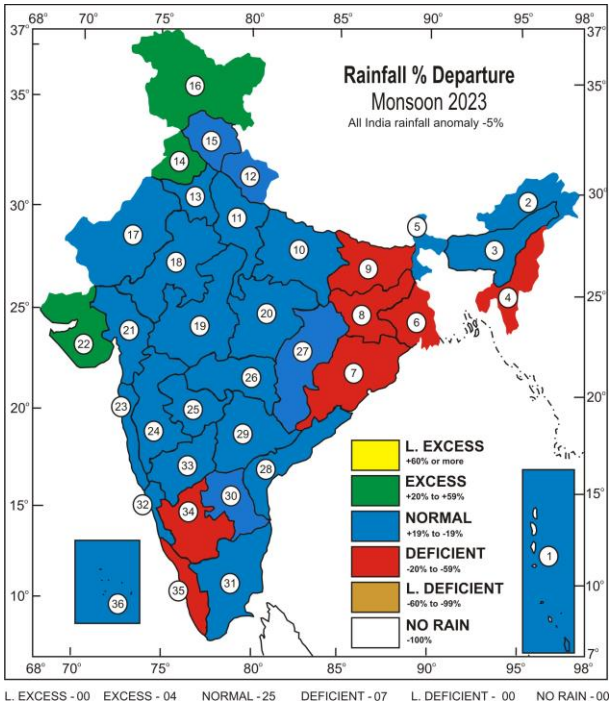


Fig. 6. Rainfall for the month of monsoon 2023 as percentage departure from normal. 36 sub-divisions are indicated by numbers on the map & bold letters in legend below. The rainfall anomaly values for these sub-divisions are indicated below :

1	55	**7**	-29	**13**	-5	**19**	3	**25**	-11	**31**	8
2	-11	**8**	-27	**14**	20	**20**	-4	**26**	-2	**32**	-13
3	-17	**9**	-23	**15**	4	**21**	-2	**27**	-6	**33**	-11
4	-26	**10**	4	**16**	42	**22**	47	**28**	-3	**34**	-28
5	7	**11**	3	**17**	-1	**23**	11	**29**	15	**35**	-34
6	-22	**12**	-1	**18**	-3	**24**	-12	**30**	-13	**36**	-15

2.3. *Seasonal rainfall distribution*

Meteorological sub–divisionwise seasonal rainfall distribution in terms of percentage departures from normal is shown in Fig. 6. Out of the total 36 meteorological sub divisions, 4 sub-divisions received excess rainfall, 25 normal (71% area of the country) and 7 sub-divisions (18% area of the country) deficient precipitation. No sub divisions recorded large excess, large deficient or no rainfall in this season.

2.4. *Withdrawal of southwest Monsoon*

Fig. 7 shows the isochrones and Table II shows the details of withdrawal of Southwest monsoon 2023. With reduction in the rainfall and formation of the anti-cyclonic circulation in lower troposphere, withdrawal of the monsoon began on 25 September 2023 against the normal circulation in lower troposphere, withdrawal of the There was no further withdrawal till 30 September, when the monsoon withdrew from major part of Northwest monsoon

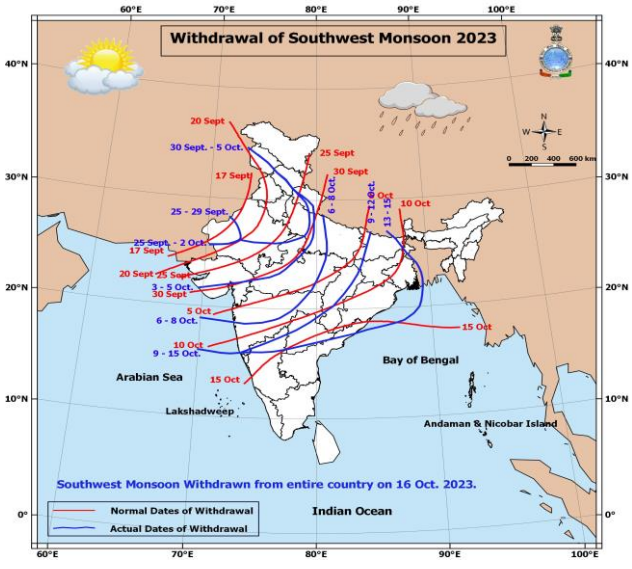


Fig. 7. Isochrones of withdrawal of SW monsoon 2023

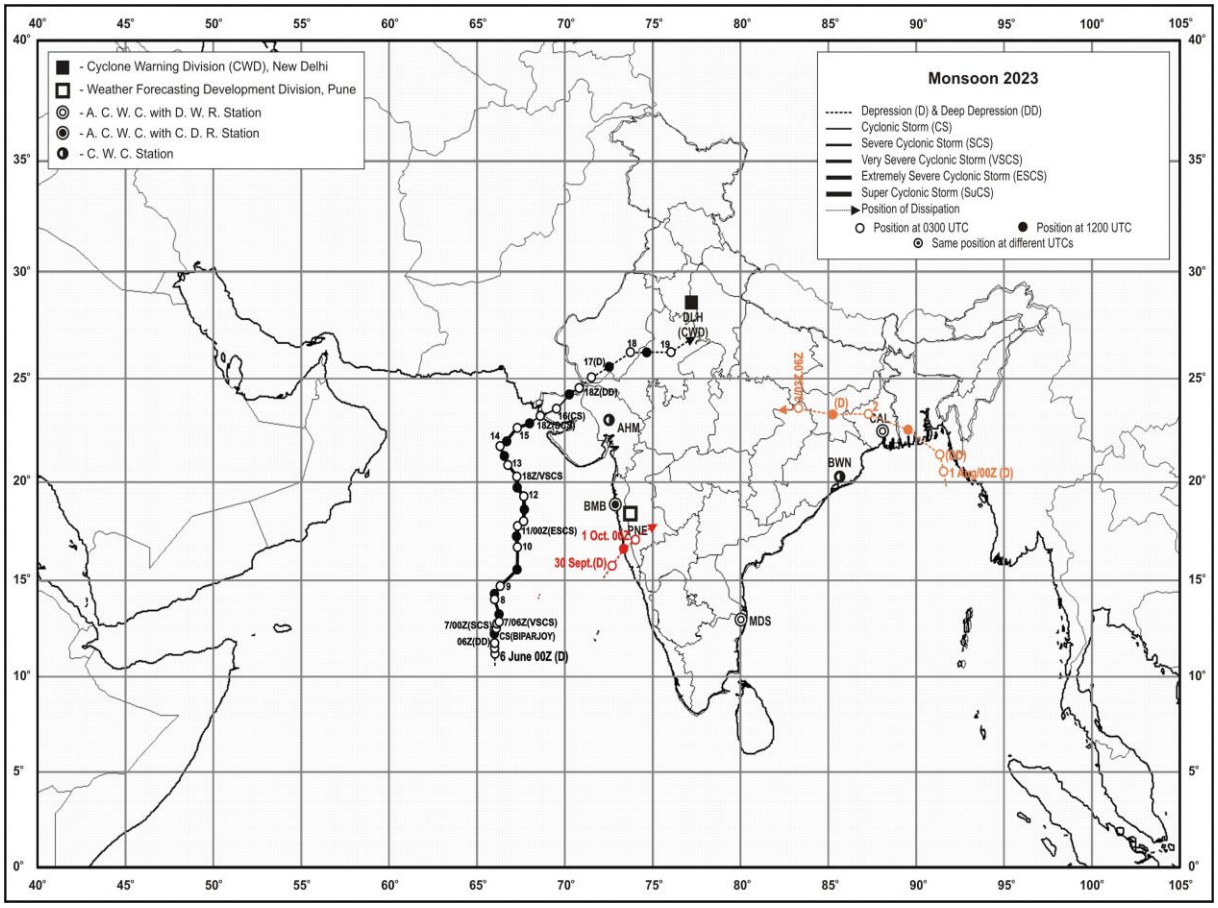


Fig. 8. Track of cyclonic storm and depression

began on 25 September 2023 against the normal date of 17 September. India and on 3 October from Gujarat and adjoining Madhya Pradesh. By 9 October, the monsoon had withdrawn from Northwest India and most parts of Central India. On 13 October, it withdrew from East India and on 16 October from the entire country, against its normal date of 15 October.

3. Chief synoptic features of southwest Monsoon 2023

The details of synoptic disturbances which affected the Indian monsoon region during June, July, August and September are given in Tables 4 to 7 respectively.

Total fourteen low-pressure systems formed during the monsoon season of 2023, out of which one intensified to Extremely Severe Cyclonic Storm (ESCS), "BIPARJOY", one Deep Depression and Depression each. During June 2023, one ESCS, formed over Arabian Sea during 6-19 June. It formed during the advance phase of monsoon and till 11 June, and aided the advance further when its remnant moved eastwards from northwest Madhya Pradesh to central parts of Uttar Pradesh during 22-25 June. The Deep Depression over northeast Bay of Bengal during August and a Depression over East central Arabian Sea from also aided the advance of monsoon from 30 September to 1 October. Other than these systems eleven low pressure areas formed out of which five intensified to Well Marked Low Pressure areas. The off-shore trough along different parts of the west coast persisted from 23 June - 11 July, 13 July - 14 July and 25 July.

TABLE 4

Details of the weather systems during June 2023

S. No.	System	Duration	Place of initial location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Low pressure area*					
1.	ESCS "BIPARJOY"	6 (0530 IST)-19(0830 IST)	Southeast Arabian sea near Lat. 11.3° N / Long. 66.0° E	Initially North and then Northeast	Central parts of northeast Rajasthan and neighbourhood	Initially it lay as a cycir over southeast Arabian sea which extended upto 5.8 km above m. s. l. on 5. Under its influence, a **low- pressure area** formed over on 5 evening. It concentrated into a **Depression** over the same region on 6. It further intensified into a **Deep Depression** at 1130 hours IST of 6 near Lat. 11.9° N / Long. 66.0° E. It intensified into a **Cyclonic Storm "Biparjoy" (pronounced as "Biporjoy")**. It further moved nearly northwards and intensified into a **Severe Cyclonic Storm** at 0530 hours IST of 7. It moved nearly north-northeastwards and intensified into a **Very Severe Cyclonic Storm** and lay centered at 1130 hours IST of 7 near Lat. 12.8° N / Long. 66.3° E. It moved north-northeastwards and intensified into an **Extremely Severe Cyclonic Storm** and lay centered at 0530 hours IST of 11 over the same region near Lat. 17.9° N / Long. 67.4° E. It weakened into a **Very Severe Cyclonic Storm "Biparjoy" a**t 2330 hours IST of 12 over northeast and adjoining eastcentral Arabian sea near Lat. 20.1° N / Long. 67.2° E. It crossed Saurashtra, Kutch and adjoining Pakistan coasts between Mandvi (Gujarat) and Karachi (Pakistan) close to Jakhau Port (Gujarat) between 2230 to 2330 Hrs IST of 15 and weakened into a **Severe Cyclonic Storm** over Saurashtra and Kutch at 2330 hrs IST. Continuing to move northeastwards, weakened into a **Cyclonic Storm** and lay centered at 0830 hours IST of 16 near Lat. 23.4° N / Long. 69.5° E. It weakened into a **Deep Depression** and lay centered at 2330 hours IST of 16 near Lat. 24.6° N / Long. 70.9° E. It weakened into a **Depression** at 1730 hours IST of 17 over south Rajasthan and adjoining north Gujarat near Lat. 25.6° N / Long. 72.5° E. It weakened at 0830 hours IST of 19 as a **well marked low pressure area** It further weakened into a **low pressure area** over northwest Madhya Pradesh, adjoining areas of northeast Rajasthan and southwest Uttar Pradesh, which became less marked on 22 evening. The associated cyclonic circulation merged with the trough from northwest Rajasthan to northeast Bay of Bengal on 26. Details are given in the article on, 'Cyclones & depression over north Indian ocean 2023'.

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2	WMLP	9-10	Northeast Bay of Bengal and neighbourhood	North	Northeast Bay of Bengal and adjoining area of southeast Bangladesh-north Myanmar coasts	Initially it lay as a cycir over north Andaman sea on 30 May. The LP became less marked on 11
3	WMLP	25-30 morning	Northwest Bay of Bengal, adjoining north Odisha-West Bengal coasts	west	Northwest Madhya Pradesh and neighbourhood	Initially it lay as a cycir over southeast Bay of Bengal at 5.8 km above m. s. l. on 16. The LP became less marked on 30 morning. The associated cycir became less marked on 6 July.
(**B**) *Western Disturbances/Eastward moving systems*						
(*i*) *Upper air cyclonic circulation*						
1	Between 3.1 and 5.8 km above m. s. l.	3-9	Iran and neighbourhood	East	Uttarakhand	Became less marked on 10.
(*ii*) *As a trough*						
1	At 5.8 km above m. s. l.	9-15	Roughly along Long. 55° E to north of Lat. 25° N	Northeast	Roughly along Long. 74° E to north of Lat. 32° N	It lay as a cyclonic circulation over Jammu - Kashmir & Ladakh and neighbourhood which extended between 3.1 and 5.8 km above m. s. l. on 16th which became less marked on 17.
2	At 5.8 m. s. l.	17	Roughly along Long. 70° E to the north of 35° N			Moved away east-northeastwards on 18.
3	At 5.8 km above m. s. l.	29 June – 1 July	Roughly along Long. 74° E to the north of Lat. 32° N	Northeast	Roughly along Long. 74° E to the north of Lat. 30° N	Initially it lay as a trough in mid tropospheric westerlies with its axis at 5.8 km above m. s. l. ran roughly along Long. 58° E to the north of Lat.30° N on 27th. It lay as a cyclonic circulation over Jammu and Kashmir at 5.8 km above m. s. l. on 28. Moved away northeastwards on 2 July.
(*iii*) *Induced cyclonic circulations*						
1.	Up to 1.5 km above m. s. l.	6	Punjab and adjoining central Pakistan	Stationary	*In situ*	Became less marked on 7.
(**C**) *Other upper air cyclonic circulations*						
1	At 1.5 km above m. s. l.	1	South coastal Andhra Pradesh and neighborhood	Stationary	*In situ*	Became less marked on 2.
2	At 1.5 kms a.s.l.	2	South Odisha and neighborhood	Stationary	*In situ*	Became less marked on 3.
3	Up to 1.5 km above m. s. l.	4	Northwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 5.
4	At 3.1 km above m. s. l.	5	Northeast Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 6.
5	Upto 1.5 km above m. s. l	1-5	Southwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 6.
6	At 0.9 kms a.s.l.	3-6	South Chhattisgarh and adjoining Telangana	Stationary	South Chhattisgarh and neighbourhood	Became less marked on 7.
7	At 5.8 km above m. s. l.	6-7	South Tamil Nadu neighbourhood	Stationary	*In situ*	Became less marked on 8.
8	Upto 1.5 km above m. s. l.	7	Southwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 8.

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
9	At 1.5 km above m. s. l.	8	North coastal Andhra Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 9.
10	At 0.9 km above m. s. l.	9-13	East Bihar and neighbourhood	Oscillatary	East Uttar Pradesh and adjoining Bihar	Became less marked on 14.
11	Upto 1.5 km above m. s. l.	9	South Chhattisgarh and adjoining Odisha	Stationary	*In situ*	Became less marked on 10.
12	Upto 4.5 km above m. s. l.	11	Northwest Bay of Bengal and neighbourhood	Stationary	*In situ*	It then lay as a trough ran roughly along Lat. 90°E to the north of 20°N between 3.1 & 5.8 km above m. s. l. which became less marked on 12.
13	At 0.9 km above m. s. l.	18-19	Northeast Bihar and neighbourhood	West	Bihar and adjoining east Uttar Pradesh	Became less marked on 20.
14	between 3.1 and 5.8 km above m. s. l.	19-20	southwest and adjoining westcentral Bay of Bengal off Tamil Nadu coast	Stationary	*In situ*	Became less marked on 21.
15	At 3.1 km above m. s. l.	23-29	Northeast Arabian Sea and adjoining Gujarat	North	South Gujarat coast and neighbourhood	Merged with the trough from the cyclonic circulation over central parts of south Uttar Pradesh and neighbourhood to northeast Arabian Sea on 30th June.
16	Between 4.5 and 5.8 km above m. s. l.	30 June-7 July	Southeast Bay of Bengal and neighbourhood		Jharkhand and neighbourhood	Became less marked on 8 july.
(**D**)	*Other troughs/Wind discontinuity*					
1	At 0.9 km above m. s. l.	3-4	From north Bihar to the cyclonic circulation over south Chhattisgarh across Jharkhand	East	From northeast Bihar to north Chhattisgarh across Jharkhand	Merged with the trough from east Bihar to Telangana on 5
2	At 0.9 km above m. s. l.	4-7	From the cyclonic circulation over south Chhattisgarh and neighbourhood to interior Tamil Nadu	*Oscillatory*	From north Chhattisgarh to north interior Karnataka across Telangana	Became less marked on 8
3	At 5.8 km above m. s. l	12-13	Roughly along Long. 87° E to the north of Lat. 24° N	East	Roughly along Long. 88° E to the north of Lat. 24° N	Became less marked on 14.
4	At 0.9 km a.s.l.	10-17	from the cyclonic circulation over east Bihar and neighborhood to south Odisha	Oscillatory	from Sub Himalayan West Bengal to south Odisha	Became less mark ed on 18.
5	At 0.9 km above m. s. l.	18	From the cyclonic circulation over northeast Bihar and neighborhood to east Vidarbha	West	From the cyclonic circulation over Bihar and adjoining east Uttar Pradesh to east Vidarbha	Became less marked on 19
6	At 1.5 km above m. s.	20	From Sikkim to south Jharkhand	Stationary	*In situ*	Became less marked on 21.

TABLE 4 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
7	At m. s. l.	20	Along southeast Arabian Sea off Kerala coast	Stationary	*In situ*	Became less marked on 21.
8	Between 3.1 and 5.8 km above m. s. l.	19-20	From the cyclonic circulation over southwest and adjoining westcentral Bay of Bengal off Tamil Nadu coast to southeast Arabian sea off Kerala coast	North	From the cyclonic circulation over southwest and adjoining westcentral Bay of Bengal off Andhra Pradesh coast to Lakshadweep area and adjoining southeast Arabian sea	Became less marked on 21
9	At 0.9 km above m. s. l.	21-30	From south Punjab to west Bihar	Oscillatory	From northwest Rajasthan to Manipur	Became less marked on 1 July.
10	Between 4.5 and 5.8 km above m. s. l.	30 June - 1 July	From the cyclonic circulation over central parts of south Uttar Pradesh and neighbourhood to northeast Arabian sea	Northwest	From the cyclonic circulation over northwest Uttar Pradesh and neighbourhood to northeast Arabian sea	Became less marked on 2 July.
(**E**)	*East-West shear zone*					
1	Between 3.1 and 5.8 km above m. s. l.	21-22	Roughly along Lat. 12° N	North	Roughly along Lat. 14° N	Became less marked on 23.

TABLE 5

Details of the weather systems during July 2023

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	Low Pressure area	9 -11	Southwest Rajasthan and neighborhood	Northeast	Northeast Rajasthan and adjoining northwest Madhya Pradesh	Initially it lay as a cyclonic circulation over northeast Arabian sea and adjoining south Gujarat which extended upto 3.1 km above m. s. l. tilting southwards with height on 6. The low-pressure became less marked on 11 morning. The associated cyclonic circulation became less marked on 15.
2	Low Pressure area	16 -17 morning	North Odisha and adjoining Gangetic West Bengal and Jharkhand	Northwest	West Jharkhand, adjoining north Chhattisgarh and north interior Odisha	Initially it lay as a cyclonic circulation over northwest Bay of Bengal and adjoining north Odisha-Gangetic West Bengal coasts which extended upto 5.8 km above m. s. l. tilting southwards with height on 15th. Under its influence, a low-pressure area formed over north Odisha and adjoining Gangetic West Bengal and Jharkhand with the associated cyclonic circulation extending upto mid tropospheric levels tilting south westwards with height on 16th. The low-pressure became less marked on 17. The associated cyclonic circulation merged with the monsoon trough on 20.
3	Low Pressure area	20 morning -21	Northwest Bay of Bengal off Odisha coast	Southwest	South Odisha – North Andhra Pradesh, adjoining northwest and west central Bay of Bengal	The LP became less marked on 22. The associated cyclonic circulation merged with the cyclonic circulation over central Madhya Pradesh on 23.

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4	WMLP	24 eve-28	West central and adjoining northwest Bay of Bengal off north Andhra Pradesh-south Odisha coasts	Northwest	North Odisha and neighbourhood	Initially it lay as a cyclonic circulation over west central and adjoining northwest Bay of Bengal between 5.8 and 7.6 km above m. s. l. on 24th morning. The LP became less marked on 28. The associated cyclonic circulation lay over north Odisha, adjoining areas of Gangetic West Bengal and Jharkhand which extended up to 5.8 km above m. s. l. tilting southwards with height on 28. It lay over Gangetic West Bengal and adjoining north Odisha on 29 morning. Under its influence, a low pressure area formed over north Odisha and adjoining south Gangetic West Bengal coast which finally concentrated to a Deep Depression.
(B) *Western Disturbances/Eastward moving Systems*						
(a) U*pper air cyclonic circulations*						
1	Mid and upper tropospheric level	13	North Pakistan and neighborhood	Northeast	Central Pakistan and adjoining Punjab	It moved away northeast wards on 18.
(b) *As Trough*						
1	At 5.8 km above m. s. l.	5-12	Roughly along Long. 68° E to the north of Lat. 30° N	Oscillatory	Roughly along Long. 77° E to the north of Lat. 28° N	Moved away on 13.
2	At 5.8 km above m. s. l.	25-26	Roughly along Long. 67° E to the north of Lat. 30° N	Northeast	Roughly along Long. 70° E to the north of Lat. 32° N	Moved away East north east on 27.
3	At 5.8 km above m. s. l.	28 July to 2 Aug	Roughly along Long. 65° E to the north of Lat. 30° N	East	Roughly along Long. 70° E to the north of Lat. 30°N	It lay as a cyclonic circulation over central Pakistan and neighbourhood at 5.8 km above m. s. l. on 4th. It lay over north Pakistan and adjoining Jammu at 5.8 km above m. s. l. on 5 which became less marked on 6.
(C) *Other upper air cyclonic circulations*						
1	Between 1.5 and 5.8 kms a.s.l.	2	North Andaman Sea	Stationary	*In situ*	Became less marked on 3
2	At 3.1kms a.s.l.	2	Sub Himalayan West Bengal and Sikkim			It lay as a trough from Sub Himalayan West Bengal and Sikkim to north Chhattisgarh across Bihar and Jharkhand at 5.8 km above m. s. l. on 3 which became less marked on 4.
3	Between 2.1 and 4.5 kms a.s.l.	3-4	South Gujarat region and neighborhood	Stationary	*In situ*	Became less marked on 5.
4	At 1.5 Kms a.s.l	5-7	North Pakistan and adjoining Punjab	East	Northwest Rajasthan and neighbourhood	Became less marked on 8.
5	At 1.5 kms a.s.l.	11	South Haryana and neighbourhood	Stationary	*In situ*	Became less marked on 12
6	At 5.8 kms a.s.l.	10-13	Southwest Bay of Bengal off north Tamil Nadu coast	Northwest	West central and adjoining southwest Bay of Bengal	Became less marked on 14.
7	At 3.1 km above m. s. l.	12	North coastal Andhra Pradesh	Stationary	*In situ*	Became less marked on 13.

TABLE 5 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
8	Between 5.8 km and 7.6 km above m. s. l.	14	North coastal Andhra Pradesh and neighborhood	Stationary	*In situ*	Became less marked on 15.
9	At 3.1 km above m. s. l.	14	Haryana and neighbourhood	Stationary	*In situ*	Became less marked on 15.
10	At 3.1 km above m. s. l.	14-15	South Gujarat and neighbourhood	Stationary	In situ	Became less marked on 16.
11	At 3.1 km above m. s. l.	18	Haryana and neighbourhood	Stationary	*In situ*	Became less marked on 19
12	At 0.9 km above m. s. l.	18	Northwest Madhya Pradesh and neighbourhood	Stationary	In situ	Became less marked on 19.
13	Up to 3.1 km above m. s. l.	19	South Punjab and neighborhood	Stationary	*In situ*	Became less marked on 20.
14	Upto 3.1 km above m. s. l.	24-26	Kutch and neighbourhood	Northeast	West Rajasthan and neighbourhood	Became less marked on 27.
15	Upto 1.5 km above m. s. l.	22-26	Southwest Madhya Pradesh and adjoining southeast Rajasthan and northeast Gujarat region	Northwest	Northwest Madhya Pradesh and neighbourhood	Became less marked on 27.
16	Up to 2.1 km above m. s. l.	21	South Chhattisgarh and neighbourhood	West		Merged with the cyclonic circulation over southeast Vidarbha and adjoining south Chhattisgarh on 22.
17	Up to 7.6 km above m. s. l.	22-23	West central and adjoining northwest Bay of Bengal	West	South Odisha and neighbourhood	Became less marked on 24.
18	Between 1.5 km and 3.1 km above m. s. l.	27	Punjab and neighbourhood	Southeast	Haryana and neighbourhood	Became less marked on 29.
19	Up to 1.5 km above m. s. l.	29	North Pakistan	East	Punjab and adjoining north Pakistan	Became less marked on 30.
(D)	*Other Troughs*					
1	At 5.8 km above m. s. l.	13	From the cyclonic circulation over central parts of south Uttar Pradesh and neighborhood to south Gujarat	Stationary	*In situ*	Became less marked on 14.
2	Between 1.5 and 3.1 km m. s. l.	28	From the cyclonic circulation over north Odisha and adjoining areas of Gangetic West Bengal, Jharkhand to west Assam	Stationary	*In situ*	Became less marked on 29.
3.	Between 0.9 and 3.1kms a.s.l.	30	From northwest Bihar to the cyclonic circulation associated with the lowpressure area over northwest Bay of Bengal and adjoining areas of north Odisha and West Bengal coasts	Stationary	*In situ*	Became less marked on 31
(E)	*East-West Shear Zone*					
1	Between 4.5 & 7.6 kms a.s.l.	4-7	Roughly along Lat. 15° N	North	Roughly along Lat. 19° N	Became less marked on 8.
2	Between 4.5 & 7.6 kms a.s.l.	17-28	Roughly along 20° N	Oscillatory	Roughly along Lat. 19° N	Became less marked on 29 morning.

TABLE 6

Details of the weather systems during August 2023

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	1 (0000UTC) -3 (1200UTC)	Northeast Bay of Bengal near Lat. 20.5° N / Long. 91.5° E.	West northwest	North Chhattisgarh and neighborhood	It formed from the remnant of the cyclonic circulation of the WMLP (24-27 July) over Gangetic West Bengal and adjoining north Odisha on 29 morning. Under its influence, a Low Pressure area formed over north Odisha and adjoining south Gangetic West Bengal coast on 29. It lay as a WML on 31 July morning. intensified into a **Deep Depression** and lay centred at 0830 hours IST of 1st August over the northeast Bay of Bengal off Bangladesh coast near Lat. 21.2° N / Long. 91.2° E. It moved west-northwestwards and crossed Bangladesh coast near Lat. 21.9° N / long. 90.3° E close to east of Khepupara during 1530 to 1630 hours IST as a Deep Depression. It weakened into a Depression on 2 August at 1730 hours IST Depression weakened into Well marked low on 3 August & Low pressure on 4 August, which became less marked on 6. The associated cyclonic circulation became less marked on 12 August over northeast Uttar Pradesh and adjoining northwest Bihar. Details are given in the article on, 'Cyclones & depression over north Indian ocean 2023'
2	Low Pressure area	17 evening-21morning	Northwest Bengal and neighbourhood	Northwest	Central parts of north Madhya Pradesh	Initially it lay as a cyclonic circulation over northeast and adjoining east central Bay of Bengal between 4.5 and 7.6 km above m. s. l. tilting southwards with height on 16. It became less marked on 21 morning and the associated cyclonic circulation became less marked on 26.
(**B**)	*Western Disturbances /Eastward moving Systems*					
(*i*)	*As A trough*					
1	At 5.8 km above m. s. l.	7-8	Roughly along Long. 68° E to the north of Lat. 30° N	Northeast	Roughly along Long. 74° E to the north of Lat. 32° N	Moved away north eastwards on 9.
2	At 5.8 km above m. s. l.	9-13	Roughly along Long. 60° E to the north of Lat. 32° N	Northeast	Roughly Long. 75° E to the north of Lat. 32° N	Moved away north eastwards on 14.
3	At 5.8 km above m. s. l.	14-15	Roughly along Long. 68° E to the north of Lat. 32° N	Northeast	Roughly along Long.75° E to the north of Lat. 32° N	Moved away north eastwards on 16.
4	At 5.8 km above m.s.l.	16-19	Roughly along Long. 68° E to the north of Lat. 32° N	East	Roughly along Long.72° E to the north of Lat. 32° N	Moved away north eastwards on 20.

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5	At 5.8 km above m.s.l.	20-30	Roughly along Long. 58° E to the north of Lat. 28° N	Northeast	Roughly along Long.78° E to the north of Lat. 32° N	Moved away north eastwards on 30 evening.
(**C**) *Other upper air cyclonic circulations*						
1	Mid tropospheric levels	1Morning	southwest Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 1.
2	At 5.8 kms a.s.l.	5	Gujarat and neighbourhood	Stationary	*In situ*	Became less marked on 6.
3	At 5.8 kms a.s.l.	7	North Gujarat and neighbourhood	Stationary	*In situ*	Became less marked on 8.
4	At 1.5 km above m. s. l.	10	west Rajasthan	Stationary	*In situ*	Became less marked on 11.
5	At 5.8 km above m. s. l.	11	Gujarat	Stationary	*In situ*	Became less marked on 12.
6	Between 4.5 & 5.8 km above m.s.l.	11-12	West central Bay of Bengal off Andhra Pradesh coast	Stationary	*In situ*	Became less marked on 13.
7	At 5.8 km above m.s.l.	13	Northwest Bay of Bengal and neighbourhood	Stationary	*In situ*	Merged with the cyclonic circulation over south Bangladesh and neighbourhood on 14th
8	Between 1.5 and 3.1 km above m.s.l.	15	Comorin area	Stationary	*In situ*	Became less marked on 16.
9	At 1.5 km above m.s.l.	15	Southwest Rajasthan and neighborhood	*Stationary*	*In situ*	Became less marked on 16.
10	Between 3.1 & 5.8 km above m.s.l.	14-15	West Madhya Pradesh	*Stationary*	Southwest Uttar Pradesh and neighborhood	Became less marked on 16.
11	At 0.9 km above m. s. l.	13-15	East Bangladesh and neighborhood	Southwest	Southwest Bangladesh and neighborhood	Initially it lay as a trough from east Bihar to northwest Bay of Bengal across West Bengal upto 1.5 km above m. s. l. on 11th Became less marked on 16.
12	Between 3.1 & 5.8 km above m.s.l.	16	Northwest Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 17.
13	Upto 0.9 km above m. s. l.	19	Northwest Madhya Pradesh and neighbourhood	East		Merged with the cyclonic circulation associated with low pressure area over northeast Madhya Pradesh and neighbourhood on 19th evening.
14	At 1.5 km above m. s. l.	19	Central Pakistan	Stationary	*In situ*	Became less marked on 20.
15	At 1.5 km above m. s. l.	22	North Tamil Nadu and adjoining Rayalaseema	Stationary	*In situ*	Became less marked on 23.
16	between 4.5 and 5.8 km above m. s. l.	23	South Gujarat	Stationary	*In situ*	Became less marked on 24.

TABLE 6 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
17	Upto 1.5 km above m. s. l.	23	Northwest Uttar Pradesh	Stationary	*In situ*	Became less marked on 24.
18	Up to 1.5 km above m. s. l.	24	Central Pakistan and adjoining west Rajasthan extending	Stationary	*In situ*	Became less marked on 25.
19	At 1.5 km above m. s. l.	27	North Tamil Nadu coast	Stationary	*In situ*	Became less marked on 28.
20	At 5.8 km above m. s. l.	29-30	Central parts of north Madhya Pradesh	South	Central Madhya Pradesh	Became less marked on 31.
21	Between 3.1 and 5.8 km above m. s. l.	2-274	Sub-Himalayan West Bengal and Sikkim	East	Assam and neighbourhood	Became less marked on 28.
22	At 1.5 km above m. s. l	28	Lakshadweep and off north Kerala coast.	Stationary	*In situ*	Became less marked on 29.
23	Between 1.5 and 4.5 km above m. s. l.	30	South interior Karnataka and neighbourhood	Stationary	*In situ*	Became less marked on 31.
24	At 0.9 km above m. s. l	31Aug.	West central Bay of Bengal off Andhra Pradesh coast.	Stationary	*In situ*	Became less marked on 1 September.
25	At 0.9 km above m. s. l.	31 Aug.	East Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 1 September.
26	Between 3.1 and 4.5 km above m. s. l.	31 Aug.	East Uttar Pradesh and adjoining Bihar	Stationary	*In situ*	Became less marked on 1 September.
(D)	*North-South Trough/Other trough*					
1	At 0.9 km above m. s. l.	11-12	From South interior Karnataka to Comorin area	Stationary	*In situ*	Became less marked on 13.
2.	At 0.9 km above m. s. l	11-16	From South interior Karnataka to Comorin area	Stationary	*In situ*	Became less marked on 17.
3	Between 3.1 and 5.8 km above m. s. l.	17	Roughly along Long. 81°E to the north of Lat. 24°N	Stationary	*In situ*	Became less marked on 18.
4	At 0.9 km above m. s. l	22-24	From South interior Karnataka to Comorin area	Oscillatory	From South interior Karnataka to Comorin area	Became less marked on 25.
5.	Upto 1.5 km above m. s. l.	23	from northwest Uttar Pradesh to south Assam		From northeast Uttar Pradesh to east Assam	Became less marked on 24.
6	Upto 1.5 km above m. s. l.	27-30	From south interior Karnataka to Comorin area	Oscillatory	From south interior Karnataka to Comorin area	Became less marked on 31.

TABLE 7

Details of the weather systems during September 2023

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*					
1.	Depression	30 Sep. (0300UTC) -1 Oct. (0300UTC)	East central Arabian Sea and lay centered near Lat. 15.9° N / Long. 72.8° E.	Northeast	south Madhya Maharashtra and neighbourhood	Initially it lay as a cyclonic circulation over north Interior Karnataka on 27 extending between 3.1 and 5.8 km above m. s. l. It lay as a low pressure area on 29 morning and WML on 30. Depression weakened into WML on 1 and into low pressure on 2 October morning and then became less marked on 2 October However, the associated cycir became less marked on 3 October. Details are given in the article on, 'Cyclones & depression over north Indian ocean 2023'
(**B**)	*Low Pressure Area*					
1	Low pressure area	5(morning)	Northwest and adjoining west central Bay of Bengal off south Odisha-north Andhra Pradesh coasts	Stationary	*In situ*	Initially it lay as a cyclonic circulation over eastcentral Bay of Bengal and neighborhood on 29th. The LP became less marked on 6, However, the associated cyclonic circulation moved towards central India and merged with cyclonic circulation associated with the well marked low pressure area over north Chhattisgarh on 15 morning.
2	Well marked Low pressure area	13-17	Central parts of north Bay of Bengal	Northwest	Southeast Rajasthan and neighbourhood	Initially it lay as a cyclonic circulation over north Andaman sea and neighbourhood at 5.8 km above m. s. l. on 15 . lay as a well marked low pressure area over northwest Bay of Bengal off north Odisha West Bengal coasts on 14 morning Became less marked on 18 evening. However, the associated cycir became less marked on 24.
3	Low pressure area	19-21	Northwest Bay of Bengal off West Bengal-Odisha coasts	North	Jharkhand and neighbourhood	It formed under the influence of the cyclonic circulation north Andaman sea and neighbourhood at 5.8 km a.s.l. on 15. The low pressure became less marked on 22. However, the associated cyclonic circulation became less marked on 27.
4	Well marked low pressure	29 Sept. morning – 2 Oct.	Northeast and adjoining east central Bay of Bengal	North north east	Central parts of Bangladesh and neighbourhood	Initially it lay as a cyclonic circulation over. Myanmar and adjoining eastcentral Bay of Bengal which extended upto 5.8 km above m. s. l. on 28. lay as a Well marked low pressure area over northwest Bay of Bengal on 30 September morning. Became less marked on 7 October evening. However, the associated cycir became less marked on 8 October.
(C)	*Western Disturbances /Eastward moving Systems*					
(*i*)	*As a trough*					
1	At 5.8 km above m. s. l.	5-7	Roughly along Long. 75° E to the north of Lat. 28° N	Northeast	Roughly along Long. 76° E to the north of Lat. 32° N	Moved away northeast ward on 8.
2	At 5.8 km a.s.l.	8-11	Roughly along Long. 65° E to the north of Lat. 28° N	Northeast	Roughly along Long. 78°E to the north of Lat. 30°N	Moved away northeast ward on 12.
3	At 5.8 km a.s.l.	16-18	Roughly along Long. 68° E to the north of Lat. 28° N	East northeast	Roughly along Long. 70° E to the north of Lat. 32° N	Moved away east-northeast ward on 19.

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4	At 5.8 km a.s.l.	24-25	Roughly along Long. 63° E to the north of Lat. 30° N	East northeast	Roughly along Long. 70° E to the north of Lat. 32° N	Moved away east-northeast ward on 26.
5	At 5.8 km a.s.l.	26 Sept. - 1 Oct.	Roughly along Long. 60° E to the north of Lat. 30° N	East	Roughly along Long. 68° E to the north of Lat. 30° N	It moved away northeast wards on 1 October.
(D)	*Other upper air cyclonic circulations*					
1	Between 5.8 and 7.6 km above m. s. l.	2	North interior Tamil Nadu	Stationary	*In situ*	Became less marked on 3.
2	At 3.1 km above m. s. l.	1-2	Comorin area	Stationary	*In situ*	It became less marked on 3.
3	At 1.5 km above m. s. l.	1	South Chhattisgarh	Stationary	north interior Karnataka	It became less marked on 3.
4	Between 4.5 and 5.8 km above m. s. l.	3	Andhra Pradesh and adjoining Telangana	Stationary	*In situ*	It became less marked on 4.
5	Between 4.5 and 7.6 km above m. s. l.	3.	Interior Odisha	Stationary	*In situ*	It became Less marked on 4.
6	Between 1.5 and 3.13 km above m. s. l.	3	Northwest Uttar Pradesh and neighbourhood	Stationary	*In situ*	It became Less marked on 4.
7	Up to 1.5 km above m. s. l.	5	Punjab and neighbourhood	Stationary	*In situ*	It became Less marked on 6.
8	At 0.9 km above m. s. l.	14	Northeast Rajasthan and neighbourhood	Stationary	*In situ*	It became Less marked on 15 morning.
9	At 0.9 km above m. s. l.	15-16	South Haryana and neighbourhood	North	Punjab and neighbourhood	It became Less marked on 17.
10	At 1.5 km above m. s. l.	27	Gangetic West Bengal and neighbourhood	Stationary	*In situ*	It became Less marked on 28.
11	Up to 2.1 km above m. s. l.	26-27	Telangana and neighbourhood extending	Northeast	south Chhattisgarh and neighbourhood	Became less marked on 28
12	Between 3.1 and 7.6 km above m. s. l.	24 evening	North interior Odisha and neighbourhood	Stationary	*In situ*	Became less marked on 25.
13	Between 4.5 and 5.8 km above m. s. l.	25-30	North coastal Tamil Nadu and neighbourhood	Oscillatory	southwest Bay of Bengal off Tamil Nadu coast	Became less marked on 1 October.
14	Between 4.5 and 5.8 km above m. s. l.	25	South Chhattisgarh and neighbourhood	Stationary	*In situ*	Became less marked on 26.
15	At 5.8 km above m. s. l.	24	Southeast Arabian sea and adjoining Lakshadweep area	Stationary	*In situ*	Became less marked on 25.
16	Between 3.1 and 5.8 km above m. s. l.	24	South Gujarat region and neighbourhood	Stationary	*In situ*	Became less marked on 25.

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
17	Between 3.1 and 5.8 km above m. s. l	23-24	South Madhya Maharashtra and neighbourhood.	Stationary	*In situ*	Became less marked on 25.
18	Up to 1.5 km above m. s. l.	23-24	North Pakistan and neighbourhood	Stationary	*In situ*	Became less marked on 25.
19	At 3.1 km above m. s. l.	21-22	Comorin area and neighbourhood	North	south Tamil Nadu	Became less marked on 23.
20	At 0.9 km above m. s. l.	28	North Madhya Maharashtra and neighbourhood	Stationary	*In situ*	Became less marked on 29.
21	Between 1.5 and 3.1 km above m. s. l	29	Northwest Uttar Pradesh and neighbourhood	Stationary	*In situ*	Became less marked on 30.
22	At 0.9 km above m. s. l	29	Central Pakistan and adjoining west Rajasthan.	Stationary	*In situ*	Became less marked on 30.
(E)	*North-South Trough/Other trough/trough in easterlies*					
1	Between 1.5 and 3.1 km above m. s. l	1	From the cyclonic circulation over northeast Bay of Bengal to north coastal Andhra Pradesh.	*Stationary*	*In situ*	Became less marked on 2
2	Up to 1.5 above m. s. l	1-2	From interior Karnataka to Comorin	Oscillatory	From Vidarbha to south interior Karnataka	Became less marked on 3
3	Between 1.5 and 3.1 km above m. s. l.	3-4	From the cyclonic circulation over northeast Bay of Bengal to north coastal Andhra Pradesh	West	From the cyclonic circulation over northwest Bay of Bengal and neighbourhood to Telangana	Became less marked on 5.
4	At 0.9 km above m. s. l.	4-5	From the cyclonic circulation over northwest Bay of Bengal and neighbourhood to east Bihar		From cyclonic circulation associated with the low pressure area over northwest and adjoining westcentral Bay of Bengal off south Odisha-north Andhra Pradesh coasts to southeast Uttar Pradesh	Became less marked on 6.
5	Between 4.5 and 7.6 km above m. s. l.	9	From cyclonic circulation over central parts of Bay of Bengal and adjoining north Bay of Bengal to north coastal Andhra Pradesh	*Stationary*	*In situ*	Became less marked on 10.
6	Between 4.5 and 7.6 km above m. s. l.	12	From cyclonic circulation over central parts of Bay of Bengal and adjoining north Bay of Bengal to north coastal Andhra Pradesh	*Stationary*	*In situ*	Became less marked on 13.

TABLE 7 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
7	Up to 4.5 km above m. s. l.	10-15	From the cyclonic circulation over northwest Madhya Pradesh and adjoining northeast Rajasthan to south Chhattisgarh	Oscillatory	From southwest Rajasthan to north coastal Odisha across the cyclonic circulation associated with well marked low pressure area over east Madhya Pradesh and Chhattisgarh	Merged with the Monsoon Trough on 16th.
8	Between 3.1 and 5.8 km above m. s. l.	15	From south Konkan to cyclonic circulation associated with well marked low pressure area over east Madhya Pradesh	Stationary	*In situ*	Became less marked on 16.
9	Up to 1.5 km above m.s.l.	18	From cyclonic circulation over southeast Rajasthan to northeast Arabian sea	Stationary	*In situ*	Became less marked on 19.
10	Upto 1.5 km above m.s.l.	23	From south interior Karnataka to Comorin area	Stationary	*In situ*	Became less marked on 24.
11	At 1.5 km above m. s. l.	27	From north coastal Karnataka to the cyclonic circulation over south Chhattisgarh	Stationary	*In situ*	It became Less marked on 28.
12	Between 4.5 and 5.8 km above m. s. l.	25-26	from cyclonic circulation over south Chhattisgarh to south Konkan	West	East Vidarbha to south Konkan	Became less marked on 27.
13	At 3.1 km above m. s. l.	24	from Jharkhand to the cyclonic circulation over south Madhya Maharashtra and neighbourhood	Stationary	*In situ*	Became less marked on 25.
14	Between 1.5 and 5.8 km above m. s. l.	22	From Sikkim to south Madhya Maharashtra	Stationary	*In situ*	Became less marked on 23.
15	At 0.9 km above m. s. l.	22-25	From cyclonic circulation associated with the Low pressure area over southeast Jharkhand to southwest Uttar Pradesh	Oscillatory	from cyclonic circulation over southeast Uttar Pradesh to west Assam	Became less marked on 26.
16	At 0.9 km above m. s. l.	28	North Madhya Maharashtra and neighbourhood			Became less marked on 29.
(F)	*East-west shear zone/trough*					
1	Between 3.1 & 7.6 km above m.s.l.	7	Roughly along 19° N	North	Roughly along 21° N	Became less marked on 9.
2	Up to 1.5 km above m.s.l..	20	From the cyclonic circulation over Kutch and neighbourhood to Punjab	Stationary	*In situ*	Became less marked on 21.
3	Between 3.1 & 4.5 km above m.s.l.	28-29	Along Lat. 15° N across the cyclonic circulation over north coastal Karnataka and neighbourhood	Stationary	*In situ*	Became less marked on 30.

TABLE 8

Representative amounts of Heavy Rainfall (12 cm and above) for June – September 2023

Date	
1 Jun	12 - Chakrata and Mussoorie.
2 Jun	Nil.
3 Jun	Nil.
4 Jun	Nil.
5 Jun	Nil.
6 Jun	Nil.
7 Jun	Nil.
8 Jun	14 - Port Blair.
9 Jun	13 - Maya Bandar.
10 Jun	19 - Bijni ARG; 14 - Manash Nh Xing; 13 - Shella.
11 Jun	18 - Long Island; 17 - Dimapur AWS; 16 -Melabazar/Matunga; 15 - Nalbari/Pagladia; 14 - Cherrapunji(rkm) and Khliehriat; 13 - Jia Bharali N T Xing and Wokha Sadar Nsdma AWS; 12 - Tangla ARG.
12 Jun	16 - Salbari; 14 - Champasari, Mathabhanga and Garubathan; 12 - Numaligarh.
13 Jun	21 - Sutrapada; 20 - Veraval and Keshod; 19 - Mendarda; 18 - Malia; 14 - Mangrol (j) ; 13 - Talala; 12 - Vanthali.
14 Jun	31 - Mawsynram; 24 - Mawkyrwat ARG; 22 - Khliehriat; 21 -Mawkyrwat; 20 - Cherrapunji; 19 - Cherrapunji (rkm) and Shella; 12 - Khambhalia.
11 Jun	21 - Shella; 20 - Mawsynram; 19 - Cherrapunji; 17 - Cherrapunji (rkm) ; 16 - Mawkyrwat; 15 - Karimganj AWS and Buxaduar; 14 - Mawphlang, Gossaigaon and MawkyrwatARG; 13 - A P Ghat, Chauldhowaghat, Cooch Behar and Amritsar AWS; 12 - Tuting.
16 Jun	43 - Cherrapunji; 41 - Cherrapunji (rkm) ; 26 - Mawsynram;20 - Gandhidham; 17 - Drf and Mawkyrwat ARG; 16 - KandlaAirport and Singhik; 15 - Goibargaon, Shella and Dwarka; 14 - Melabazar/Matunga, Mawkyrwat and Shipgyar; 13 - Bhuj,Mundra, Anjar, Khliehriat and Chungthang.
17 Jun	23 - Okha; 22 - Anjar and Mandvi (k) ; 21 - Bhachau and Nongstein; 19 - Rapar and Mundra; 17 - Kandla New, Nakhatrana and Nagarkata; 16 - Cherrapunji, Kamalpur and Jamnagar; 15 - Neora and Gandhidham; 14 - Cherrapunji (rkm) and Sedwa SR; 13 - Chengmari/Diana, Khambhalia, Mounntabu Tehsil SR and Bhuj; 12 - Karimganj AWS, B P Ghat, Alipurduar PTO, Kandla Airport and Chungthang.
18 Jun	47 - Ahore SR; 46 - Jalore; 36 - Mounntabu Tehsil SR; 33 - Jaswantpura; 32 - Raniwada SR; 31 - Sheoganj; 30 - Sanchore; 27 - Sumerpur SR and Chotan; 26 - Dorimanna SR; 24 - Siwana SR, Reodar SR and Bali; 23 - Bagoda SR andErinpura/Jawai; 22 - Bhinmal; 21 - Barobhisha, Kokrajhar and Amirgadh; 20 - Abu Road SR and Pali; 19 - Sedwa SR and Gossaigaon; 18 - Balotra SR, Cherrapunji (rkm) , Desuri and Pindwara; 17 - Cherrapunji and Danta; 16 - Dhanera andChepan; 15 - Deogarh, Dantiwada, Mawkyrwat and Poshina; 14 - Panbari, Gudamalani SR and Palanpur; 13 - Margao, Buxaduar, Radhanpur, Santalpur, Alipurduar (state) , Sirohi,Deesa, Bahalpur, Pachpadra, Marwar Junction and AlipurduarPTO; 12 - Mangaluru AP, Gogunda SR, Hasimara, Amfu Pundibari, Kumbhalgarh SR and Sevoke
19 Jun	38 - Desuri; 35 - Sheoganj; 33 - Bali; 31 - Nagrarfort SR; 28 - Sumerpur SR; 27 - Deogarh; 26 - Mawsynram; 25 - Kumbhalgarh SR; 24 - Erinpura/Jawai and Amet; 23 - Gossaigaon and Cherrapunji; 22 - Rajsamand and Kokrajhar;21 - Nagarkata; 20 - Aie Nh Xing, Cherrapunji (rkm) ,Chengmari/Diana and Bijni ARG; 19 - Bahalpur; 18 - Sevokeand Chepan; 17 - Barpeta ARG, Barobhisha, Ahore SR and Manash Nh Xing; 16 - Chennai AP, Mounntabu Tehsil SR andAjmer Tehsil SR; 15 - Bagrakote, Barpeta/Sarbhog AWS,Neora, Reodar SR, Deoli, Pushkar SR, Srinagar SR and Mawkyrwat ARG; 14 - Alandur, Marwar Junction, AlipurduarPTO, Taramani ARG, Beky Rly.bridge and Nainwa; 13 - Mandal SR, Shella, Ajmer, Kumargram, Piplu SR, Barpeta, Danta, Alipurduar (state) , Chembarambakkam ARG and Tonk; 12 - Mawkyrwat and Kekri SR.

TABLE 8 (*Contd.*)

20 Jun	20 - Mohitnagar; 19 - Dinhata, Dholpur Tehsil SR and Haldibari; 17 - Beki Mathungari; 15 - Alipurduar (state) andAjmer; 14 - Karimganj and Ater; 13 - Melabazar/Matunga, Morena-aws, Cherrapunji (rkm) and Khairagar; 12 – Banera SR, Gormi, Ambah and Udalguri AWS.
21 Jun	78 - Manash Nh Xing; 24 - Chhibramau; 23 - Chepan and Melabazar/Matunga; 21 - Barobhisha; 20 - Mohitnagar and Goibargaon; 19 - Haldibari, Dinhata, Drf and Tamulpur; 18 - Hazuah; 17 - Panbari; 16 - Beky Rly.bridge, Gossaigaon, Shella and Barpeta; 15 - Alipurduar (state), Alipurduar PTO and Kokrajhar; 13 - Mainpuri, Cherrapunji, Cooch Behar and Falakata; 12 - Barpeta/Sarbhog AWS, Nh31 Bridge, Bijni ARGand Amfu Pundibari.
22 Jun	37 - Mawkyrwat ARG; 31 - Mawkyrwat; 29 - Rath and Mawsynram; 25 - Bijni ARG; 21 - Manash Nh Xing; 20 -Williamnagar and Bahalpur; 19 - Niwari; 18 - Melabazar/Matunga, Mohitnagar, Hazuah and Beki Mathungari; 17 - Panbari; 16 - Cherrapunji and Kulpahar; 15 Barobhisha, Goalpara CWC, Chepan and Orchha; 14 - Beky Rly.bridge, Charkhari, Jalpaiguri, Goibargaon and Mahoba; 13 Aie Nh Xing, Tura Kvk, Nongstein, Barpeta and WilliamnagarAWS; 12 - Khliehriat, Mauranipur and Alipurduar (state) .
23 Jun	15 - Kishanganj and Kajolgaon AWS; 13 - Manki; 12 - Dighalbank and Bhoranj.
24 Jun	16 - Kataula and Begumganj; 15 - Loharkhet, Kasauli, Nepanagar and Lakhnadon; 14 - Kangra AP and Karwar; 13 -Dharampur and Komna; 12 - Sama, Jawar and Honavar.
25 Jun	21 - Najibabad; 18 - Santacruz ; 17 - Sambalpur; 15 - Tala,Kuchinda and Pallahara; 14 - Palghar ARG, Matheran, HarnaiIMD, Hemgiri and Deogaon; 13 - Dhankauda, Sarkaghat, Mawana, Jamankira, Hardwar and Panvel ARG; 12 -Canacona, Lanja, Deogarh and Narendranagar.
26 Jun	20 - Banarpal; 19 - Paikmal and Tehri (CWC) ; 17 - Angul; 16 - Patnagarh and Padampur; 15 - Kanth, Rishikesh, Jharbandhand Roha; 14 - Mahasamund, Honavar, Chhibramau, Dahanu, Hindol, Umergam and Kaniha; 13 - Mahabaleshwar, Hirakud, Manki, Mana-Raipur-AP and Shikohabad; 12 -Talasari, Simdega, Deogarh, Takhatpur and Betul.
27 Jun	22 - Dondilohara; 20 - Sakoli; 19 - Balod; 17 - Mohla, Dheemarkheda, Umariyapan and Lakhnadon; 16 - Bhandara,Gadarwara, Tamia and Dongargaon; 15 - Arjuni Morgaon, Deori, Tendukheda, Dhamtari, Doundi and Rajim; 14 - Gurur, Chhuria, Chakradharpur, Korchi, Lakhani and Harrai; 13 - Sagar Island, Umergam, Salekasa, Umaria-aws, Kareli and Venkatnagar; 12 - Pen, Rajnandgaon, Dongargarh, Bhiwandi, Matheran, Bankhedi, Pachmarhi, Kurud, Sadakarjuni, Bhograi and Magarlod.Narsinghpur AWS 19.2
28 Jun	25 - Kareli; 22 - Narsinghpur-aws; 21 - Diamond Harbour; 20 Panjim ; 19 - Mulki, Dondilohara and Dabolim N.a.s.- Navy;18 - Mormugao - Pmo IMD and Mapusa; 17 - Bayar AWS; 16 North Paravur AWS, Karwar and Korchi; 15 - Bardoli, Mangalore/P.bur, Mattannur ARG and Kannur Airport AWS; 14 Deori, Mandla, Mangaluru AP, Valod, Malanjkhand, Ponnani, Taliparamba, Wada and Mahuva; 13 - Navsari, Madhbun, Mangaluru, Birsa, Palghar ARG, Daman ARG and Mohla; 12 - Margao, Canacona, Manki, Belikeri, Surat Kvk AWS andIrikkur.
29 Jun	25 - Palghar ARG; 21 - Panna-aws; 20 - Durgachack and Tbia IMD Part Time; 19 - Wada and Shriwardhan; 18 - Bhiwandi, Dahanu , Mawkyrwat ARG and Diu; 17 - Mawkyrwat, Cherrapunji (rkm) , Cherrapunji, Banda CWC, Ulhasnagar andPardi; 16 - Ambernath, Shella, Igatpuri and Pathari; 15 - Vikramgad, Lateri, Vasai, Colaba , Kamrej and Khergam; 14 -Shahapur, Digha, Damoh-aws, Palsana, Murud, Dharampur, Tala, Uran and Valsad; 13 - Vapi, Umergam, Guhagarh, Sevoke, Sleemanabad and Kanpur Teh; 12 - Darjeeling,Bilhari, Devgad, Bina, Gonour, Valsad Kvk AWS, Santacruz , Valod and Sudhagad Pali.
30 Jun	26 - Junagadh; 23 - Mahuva and Valod; 22 - Junagarh AWS; 19 - Vyara, Mawsynram and Anjar; 18 - Dolvan; 17 - Akkalkuwa, Falakata, Talala and Amaur; 16 - Pen, Mendarda,Bayad ARG, Sutrapada and Jamkandorna; 15 - Visavadar, Uran, Kandla New, Mawkyrwat ARG, Bhesan, Mapusa, Baltaraand Cherrapunji (rkm) ; 14 - Bardoli, Chotila, Dhoraji, Pirpaiti, Jalalgarh, Amdabad, Dabolim N.a.s.- Navy, Mormugao - Pmo IMD and Patna Aerodrome; 13 - Navasari AWS, Hajipur, Khanpur REV, Vikramgad, Vansda, Cherrapunji,Una, Upleta, Tilakwada, Vadia, Mawkyrwat, Badamalhera, Sabour and Jetpur; 12 - Patti, Chachoda, Manghi, Ukai, Dapoli ARG, Panjim , Vanthali, Mahabaleshwar, Bayad, Subir,Chikhli, Gandevi, Khergam, Kukarmunda, Jalalpor and Songadh.
1 Jul	40 - Visavadar; 27 - Jamnagar; 25 - Kaprada and Chanderdeepghat; 24 - Anjar; 22 - Cherrapunji, Bansi CWCand Khergam; 21 - Kakrahi; 20 - Bagasra, Shella and Bhesan; 19 - Mandangad, Matheran and Domeriaganj; 18 -Jamnagar Kvk AWS; 17 - Becharaji, Dharampur, Tulasipur,Rajula, Madhbun and Banbasa; 16 - Chikhli, Thane, Uska Bazar Fmo and Bamongola; 15 - Mehdawal, Junagadh,Ayoadhya, Haidargarh, Habibpur, Dangs (ahwa) , Pen, Lonavala ARG, Silvassa and Waghai; 14 - Jamkandorna, Khalapur, Ozharkheda - Fmo, Mukhlispur, Valsad Kvk AWS,Vanthali, Vansda and Forbesganj; 13 - Bardoli, Amreli Kvk AWS, Cherrapunji (rkm) , Karjat ARG, Amreli, Daman ARG,Gandevi, Barvala, Dang Kvk AWS and Narsinghpur; 12 - Gandhidham, Rajapur, Chanchal, Jafrabad ARG, Mormugao-Pmo IMD, Murbad, Shahapur, Vyara, Daman Fmo, Daman, Jetpur and Barvala ARG.
2 Jul	30 - Mawsynram; 24 - Chepan; 23 - Dharampur; 22 - Barobhisha and Shella; 21 - Alipurduar PTO, Kaprada and Khergam; 20 - Rajmahal and Williamnagar; 19 - Cherrapunji(rkm) ; 18 - Jhanjharpur and Pardi; 17 - Darauli, Visavadar and Silvassa; 16 - Cherrapunji; 15 - Valsad Kvk AWS and Bhesan; 14 - Nanipalson; 13 - Chhota Udepur, Ankleshwer,Pen and Dhari; 12 - Hazuah, Chikhli, Madhbun, Bharuch, Dhandhuka ARG, Quepem, Mokheda - Fmo, Falakata andMawkyrwat.
3 Jul	29 - Cherrapunji (rkm) ; 24 - Mawsynram; 22 - Bhaghmara;18 - Cherrapunji; 17 - Quepem, Amrapara and Margao; 16 -Hasimara and Sikatia; 15 - Godda, Mawkyrwat ARG, Sanguem and Nh31 Bridge; 14 - Rajmahal; 13 - Dodamarg,Pernem, Mawkyrwat, Godda Kvk AWS, Shella and Laxmipur;12 - Alipurduar (state) , Mendarda, Mawphlang, Khliehriat, Kudulu, Bhiwandi and Gangarampur.

TABLE 8 (*Contd.*)

4 Jul	17 - Mulki; 15 - Panambur, Cherthala, Cherthala AWS and Mangaluru; 14 - Ranni AWS, Harnai IMD, Kudulu, Kottayam and Alibag - IMD Part Time; 13 - Kumta, Baheri, Kumarakam,Laha AWS, Ernakulam South, Chinnakalar and Dapoli ARG;12 - Dhubri IMD, Tura Kvk, Kochi IAF, Mangaluru AP, Ankolaand Tenali.
5 Jul	24 - Rameshwar ARG; 22 - Devgad; 19 - Peermade To andVadakara; 18 - Shirali, Madhepur, Karwar, Honavar and Avalanche; 17 - Canacona, Mulki and Padinjarathara Dam AWS; 16 - Ponnani, Enamakkal, Kvk Dhalai, Kanjirappally and Belthangadi; 15 - Amarpur, Chinnakalar, Chalakudi, Karkala,Udupi, Alwaye PWD, Tellichery, Mahe, Kozhikode and Phulparas; 14 - Irikkur, Kamalpur, Ams Kannur, Jhanjharpur,Kannur, North Paravur AWS, Malvan, Quepem, Taliparamba, Chemberi AWS and Thycauttussery AWS; 13 - Vaikom, Kusmi, Athirappalli AWS, Kollur, Pawayan, Khowai, Kondapak,Perumpavur, Mirdoddi, Kunnamkulam, Idamalayar Dam AWS,Padannakkad AWS and Aluva AWS; 12 - Bayar AWS, Nirmali,Kumta, Panjim , Kalamassery AWS, Gersoppa, Margao, Mangaluru AP, Tibri, Kochi IAF, Kodungallur, Mani, Mangaluru,Naga Reddipet, Kollapur, Thennala AWS, Kurudamannil, Kunnathanam AWS, Mattannur ARG, Khaknar and Munnar Kseb.
6 Jul	33 - Mulki; 29 - Kota; 25 - Karkala; 24 - Vellarikkundu AWS;23 - Panambur, Udupi and Manki; 22 - Mahe; 21 - Tellichery, Mangaluru, Shirali and Peringome AWS; 20 - Avalanche,Vadakara and Kundapur; 19 - Bayar AWS, Kannur, Kadra, Mangaluru AP, Ponnani, Kannur Airport AWS and Milak; 18 -Ams Kannur, Taliparamba, Karwar, Vilangad AWS, Vaibhavwadi and Cheruvanchery AWS; 17 - N.lakhimpur/Lilabari, Mirganj, Padinjarathara Dam AWS, Padannakkad AWS, Muliyar AWS, Canacona, Cherrapunji andGersoppa; 16 - Irikkur, Mattannur ARG, Naharlagun, Bul Irr and Panjim ; 15 - Madikkai AWS, Palghar ARG, Rajapur, Mani,Puttur HMS, Sanguem, Cherrapunji (rkm) and Siddapura; 14 Thritla, Pattembi, Rameshwar ARG, Hosdurg, Margao and Mormugao - Pmo IMD; 13 - Mapusa, Laksar, Pernem, Ponda,Kankavli, Kudal, Honavar, Dabolim N.a.s.- Navy, Doraha Irr,Tikamgarh-aws, Aurphambra Road ARG, Sulya, Barkote, Mawsynram, Quilandi, Kudulu, Belthangadi and Kashipur; 12 Nadiad, Jansath, Dehra Dun, Irinjalakuda, Jatton Barrage, Devgad, Bhagamandala, Kumta, Quepem, Khambhat, Gaganbawada, Kollur, Aralam AWS, Castle Rock, Ankola and Itanagar.
7 Jul	23 - Bhagamandala; 20 - Dabri Fmo; 18 - Manki and Udupi;17 - Uppinangadi; 16 - Mawsynram; 15 - Kadra; 14 - Sevoke, Chauldhowaghat, Puttur HMS, Mani, Avalanche, Cherrapunji (rkm) , Mandangad, Murti and Sulya; 13 -Mangaluru AP, Umari, Garubathan, Panambur, Neora,Canacona, Dapoli ARG, Pen and Matheran; 12 - Harnai IMD,Virajpet, Bagrakote and Mirganj.
8 Jul	19 - Dapoli ARG; 18 - Porbandar; 17 - Gangapur; 16 - Sapotra, Mandangad and Matheran; 15 - Buxaduar, Kollur,Baheri and Amini; 14 - Mahabaleshwar, Harnai IMD, Mawsynram, Pratapgarh, Sheoganj, Rajapur and Aspur; 13 -Wakwali ARG, Bhalukpong, Shriwardhan, Pen and Kumta; 12 - Padinjarathara Dam AWS, Sudhagad Pali, Dhandhuka,Suvasara, Venkatnagar and Gersoppa.
9 Jul	30 - Chandigarh; 29 - Chandigarh IAF and Chandigarh AWS; 28 - Nangal; 27 - Balachaur AWS, Ballowal Saunkri and Ropar; 25 - Radaur and Tibri; 24 - Ropar Kvk AWS, Kalka andPanchkula; 23 - Morni, Raipur Rani, Kathua Kvk and Una Rampur AWS; 22 - Ambala, R L Bbmb, Barwala and Kathua; 21 - Gurudaspur; 19 - Madhopur, Rohru and Anandpur Sahib;18 - Sangraha; 17 - Dhariwal Irr, Una, Saraswati Nagar, Kasauli, Mehre (barsar) , Kahu, Dehra Gopipur, Bangana Rand Ghamroor; 16 - Naina Davi, Chuari, Nadaun and Barghat; 15 - Nissing REV, Bhainsdehi, Safdarjung, NagrotaSurian, Mulki, Sangaria SR, Nakur, Barthin, Arki, Malikpur, Chamba AWS and Guler; 14 - Nawanshahr, Mathabhanga, Pachhad, Shahpur Kandi, Ladwa, Kharar, Gurdaspur AWS, Gurdaspur AMFU, Damla AWS and Dalhousi Alha AWS; 13 -Hoshiarpur, Aghar, Baheri, Jatton Barrage, Naliya, Dasuya, Delhi Ridge, Ferozepur, Badarwah, Bhaderwah ARG, BabainREV, Bilaspur Sadar, Dharmsala, Manali, Jogindarnagar, Nahan, Kandaghat, Adampur, Indri, Jhansa Irr, Aliwal, Sadhaura and Aurphambra Road ARG; 12 - Manki, Taran Taran, Rai REV, Garhshankar, Pusa AWS, Mukerian, Udaipur- wati, Balachaur, Jamnagar, Delhi University AWS and Lodi Road.
10 Jul	35 - Ropar; 26 - Rajpura; 24 - Ismailabad; 23 - Mounntabu Tehsil SR; 22 - Tajewala, Pachhad and Mandkhola AWS; 20 - Partapnagar REV, Balachaur AWS, Naina Davi and Ballowal Saunkri; 19 - Adampur ARG, Dharmshala AWS, Ropar Kvk AWS, Shahbad and Chuari; 18 - Pehowa and Fatehgarh SahibAWS; 17 - Anandpur Sahib, Arki and Una; 16 – Chandigarh IAF, Ambala REV, Santalpur, Renuka/Dadhau, Rohru and Abu Road SR; 15 - Kotdasangani, Nangal, Saharanpur, Sangraha,Mehre (barsar) , Mansa, Sirhind, Fatehgarh Sahib and Sadhaura; 14 - Balachaur, Nahan, Ajmer Tehsil SR, Sleemanabad, Bijadandi, Dandh REV, Jhansa Irr, Behat and Dharampur; 13 - Barthin, Sujanpur Tira, Sarkaghat, BanganaR, Upleta, Abdasa, Khambhalia, Dadupur, Kasauli, Suigam, Patiala and Ulhasnagar; 12 - Nanipalson, Mandi, Panchkula, Gohar, Kharar, Dhanora, Kalka, Mawana, Talod, Naraingarh, Bayad ARG, Chaupal, Kandaghat and Lodi Road.
11 Jul	41 - Mawsynram; 31 - Rishikesh; 25 - Nahan; 24 – Jatton Barrage; 23 - Roshnabad; 21 - Chandigarh IAF, Hardwar andBehat; 20 - Kasauli and Tajewala; 19 - Sangraha, Renuka/Dadhau and Naina Davi; 18 - Ambala; 16 - Partapnagar REV; 15 - Laksar, Falakata, Dadupur, Idar, Morni,Rohru and Naraingarh; 14 - Talod, Solan, Jagadhari, Sirhind and Fatehgarh Sahib; 13 - Kalka, Modasa, Lunawada, Virpur,Jainoor and Sheoganj; 12 - Gohar, Rajgarh, Kandaghat, Saharanpur, Ambala REV, Mawkyrwat ARG, Jollygrant, Upleta,Panchkula, Santrampur, Dhansura, Narendranagar, Utnur and Wankdi.
12 Jul	41 - Mawsynram and Cherrapunji (rkm) ; 26 - Elgin Bridgeand Cherrapunji; 23 - Mawkyrwat; 21 - Thakurganj, Tedhagach, Kaiserganj and Bagh; 20 - Alipurduar (state) ; 19 Falakata, Amfu Pundibari and Mawkyrwat ARG; 18 - Alipurduar PTO and Taibpur; 17 - Rishikesh and Tura AWS; 15 Ramnagar and Alot; 14 - Haidargarh, Mohitnagar andMawphlang; 13 - Bajna, Shihor, Sirauli Gauspur Tehsil, Haldibari and Dadupur; 12 - Roing, Fatehpur Tehsil and Pauni.
13 Jul	54 - Mawsynram; 29 - Chengmari/Diana; 27 – Basl Manampoondi; 25 - Mangan; 24 - Singhik, Cherrapunji (rkm)and Sankalan; 22 - Laksar; 21 - Sambhal, Rscl-2 Soorapattu,Bhimpur, Mawkyrwat and Buxaduar; 20 - Basl Mugaiyur, Cherrapunji and Nagarkata; 19 - Salbari, Murti and Roorkee;18 - Kollur; 17 - Gajoldoba, Siddapura and Roshnabad; 15 - Amreli, Bagrakote, Bijnor, Champasari, Bagdogra IAF and Rscl-2 Kedar; 14 - Kumargram; 13 - Jansath, Jatton Barrage,Gersoppa, Saharanpur, Akola, Mawkyrwat ARG, Roing, Nasrullahganj, Kalapipal and Amreli Kvk AWS; 12 – Safipur, Kaptipada, Khirkiya-arg, Manki, Birpur, Chikhli, Tajewala,Shipgyar and Galgalia.

	TABLE 8 (*Contd.*)
14 Jul	21 - Bahadurganj; 20 - Cherrapunji (rkm) and Cherrapunji; 19 - Bilari; 18 - Kotdwara; 17 - Dighalbank; 15 - RameshwarARG, Bagrakote, Manki, Anta SR, Quepem, Sanguem and Pernem; 14 - Kudal; 13 - Tirwa, Gossaigaon, Jalpaiguri, Ankola, Mapusa, Mohitnagar, Mawsynram and Ponda; 12 - Malvan, Dodamarg, Karwar, Saloni, Mulde ARG, Navipet and Sawantwadi.
15 Jul	15 - Barghat; 14 - Sagar-aws and Dinhata; 13 – Dharmsala and Keshod AP; 12 - Bhiwandi, Banswada, Sama and Sahaswan.
16 Jul	21 - Kirmira; 19 - Laikera and Mon Sadar Nsdma AWS; 17 - Bhadrak; 16 - Kuchinda; 15 - Palampur and Dhamnagar; 14 - Bramhapuri, Kolabira, Bhandaripokhari and Saoli; 13 -Tuensang, Jharsuguda, Kantapada, Jagatsinghpur, Alipingaland Waraseoni; 12 – Chauldhowa ghat, Deori, Chhota Udepur, Banaigarh, Lahunipara, Herhanj and Nagbhir. Mahuva (B) 12.3
17 Jul	17 - Binika; 15 - Dhankauda and Bhandara; 14 - Chomu, Jujumura and Arang; 13 - Mounntabu Tehsil SR, Bargarh and Sambalpur; 12 - Loharkhet and Batli.
18 Jul	30 - Gudvela; 25 - Mangaon; 23 - Khalapur; 22 - Sama; 21 -Lonavala ARG; 19 - Pen and Th Rampur; 18 - Karlamunda, Mussoorie and Mahabaleshwar; 17 - Matheran, Karjat ARG and Kapkot; 16 - Tala and Babai (makhan Nagar) ; 15 - Uran,Poladpur, Laksar and Goharganj; 14 - Roha and Pakhanjur; 13 - Pipariya; 12 - Castle Rock, Jatton Barrage, Mulchera, Sangod, Renuka/Dadhau, Sudhagad Pali, Santacruz and Loharkhet. Bolangir 16.3
19 Jul	54 - Sutrapada; 52 - Veraval; 34 - Matheran; 31 - Katra; 30 -Talala and Udhampur (IAF) ; 29 - Dhoraji; 28 - Mahabaleshwar; 25 - Karjat ARG; 24 - Chandrapur and Castle Rock; 23 - Pen and Daman; 22 - Poladpur and Kodinar; 21 - Lonavala ARG, Daman Fmo, Khalapur, Daman ARG and Reasi ARG; 20 - Chitrakunda K Guma and Valpoi; 19 - Mahad, Mangrol (j) and Korukunda; 18 - Jamkandorna and Malkangiri; 17 - Sawantwadi, Gidam, Uran and Sudhagad Pali; 16 - Kalyan and Chiplun; 15 - Londa, Ballarpur, Devgad, Mulde ARG, Khed, Wakwali ARG and Lanja; 14 - Manuguru, Yellapur, Maregaon, Chatha Agro AWS, Dummugudem, Gaganbawada and Kankavli; 13 - Dharmsala, Bhairamgarh, Mangaon, Dodamarg, Rishikesh, Kudal and Jammu AP; 12 -Dapoli ARG, Upleta, Alibag - IMD Part Time, Joida, Aswapuram and Jammu AWS. Chandrapur – 19.9
20 Jul	40 - Matheran; 34 - Mangrol (j) ; 31 - Dahanu , Mahabaleshwar, Poladpur, Ulhasnagar and Umergam; 30 - Dapoli ARG; 29 - Panvel ARG and Ambernath; 28 – Lonavala ARG and Mahad; 27 - Mandangad, Karjat ARG, Palghar ARG and Pen; 26 - Bejjur; 23 - Mhasla, Bhiwandi and Wakwali ARG; 22 - Khalapur, Uran, Chiplun and Malia; 21 - Vapi and Daman; 20 - Sangameshwar Devrukh, Mangaon, Vasai and Sudhagad Pali; 19 - Jamjodhpur, Pardi, Daman Fmo, Thaneand Roha; 18 - Kutiana, Murbad and Khed; 17 - Zaffergadh and Castle Rock; 16 - Junagadh; 15 - Surat City, Sojitra, Tala, Kalyan and Gaganbawada; 14 - Kalavad, Vallabhipur, Manavadar and Sankheda; 13 - Keshod, Dhoraji, Jagalbet, Daman ARG, Bijapur, Medak, Gudurwrgl, Harnai IMD, Tbia IMD Part Time, Jagadevpur, Raghunathpalle and Gandhari;12 - Yellapur, Yaval, Ghanpur, Upleta, Surat AWS, Hansot, Kowdipalle, Tekmal, Lalpur, Mirdoddi, Parvathagiri, Tarapur, Valsad and Wankdi.
21 Jul	24 - Dwarka; 23 - Castle Rock; 22 - Mulde ARG and Sawantwadi; 21 - Degloor - Fmo and Malvan; 20 - Kudal; 17 - Gangadhara and Hadgaon; 16 - Porbandar and Vengurla; 15 - New Harsud, Vasai, Palampur and Umari; 14 – Ichhawar, Nayagarh, Mul, Kinwat, Dodamarg and Kankavli; 13 - Dharmabad, Matheran, Bolagarh, Vaibhavwadi, Gandeed, Manavadar and Khambhalia; 12 - Mangrol (j) , Abdasa, Dhrol, Gaganbawada, Jamkandorna, Khalwa, Devgad, Chevella, Sarangapurnrl, Saoli, Linganamakki HMS, Sironchaand Naliya.
22 Jul	32 - Yeotmal; 28 - Castle Rock; 26 - Kaprada; 23 - Mahagaon; 22 - Khambhalia and Sirpuru; 20 - Santacruz ,Visavadar and Khanvel; 19 - Murtajapur and Renuka/Dadhau; 18 - Jainoor, Umari and Nanipalson; 17 - Gaganbawada, Subramanya, Madhbun, Pardi, Vapi and Mahur; 16 - Arni, Mahad and Valsad Kvk AWS; 15 - Jatton Barrage, Pen, Pombhurna, Mahabaleshwar and Telhara; 14 - Kalamb, Pernem, Ghatanji, Silvassa, Jagalbet, Daman ARG, Kinwat and Wada; 13 - Haripur, Tbia IMD Part Time, Ulhasnagar, Ambernath, Palghar ARG, Jawhar and Mapusa; 12 - Yellapur, Jharda, Tonkhurd, Haldwani, Kolayat Magra, Daman, Daman Fmo, Darwha, Boath, Bazarhathnoor, Bhiwandi, Sawantwadi, Dodamarg, Rajapur and Adilabad. Yeotmal - 23.6
23 Jul	31 - Navsari; 28 - Jalalpor and Castle Rock; 27 - Navasari AWS; 24 - Junagadh and Bhagamandala; 23 - Karkala; 22 -Mulki and Udupi; 21 - Gaganbawada; 20 - Umrala; 19 - Keshod and Abad City; 18 - Vellarikkundu AWS, Khergam andMendarda; 17 - Khambhalia, Barwaha, Kottigehara, Belthangadi, Vallabhipur and Jagalbet; 16 - Matheran, Mahabaleshwar, Gandevi, Subramanya and Gersoppa; 15 -Uppinangadi, Mani, Dodamarg, Bhiwandi, Kota, Mc Ahmedabad ARG, Visavadar and Bharuch; 14 - Lonavala ARG, Nalagarh, Avalanche, Mangaluru AP, Kapurthala, Dharmasthala, Puttur HMS, Pen, Vagra and Linganamakki HMS; 13 - Siddapura, Muliyar AWS, Sulya, Panambur, Burhanpur, Napoklu, Siddapur, Botad, Ams Kannur and Roha;12 - Kalasa, Pernem, Jayapura, Kumta, Bajna, Kudulu, Aralam AWS, Bhavnagar, Dharampur, Vaibhavwadi and Kannur Airport AWS.
24 Jul	20 - Bhagamandala and Siddapur; 19 - Castle Rock; 18 -Chintur, Mahabaleshwar and Gersoppa; 17 - Yellapur, Lonavala ARG and Subramanya; 16 - Mani, Kottigehara,Matheran and Pen; 15 - Napoklu; 14 - Hunchadakatte, Murnadu, Mulde ARG, Kadra, Manki and Kumta; 13 - Somwarpet, Thalaguppa, Aizawl, Koppa, Shirali, Kammardi,Honavar, Kollur and Loharkhet; 12 - Radhanagari, Karjat ARG, Uppinangadi, Bhavnagar, Luxettipet, Linganamakki HMS, Kudal and Malvan.
25 Jul	40 - Velpur; 38 - Avalanche; 23 - Bheemgal and Jakranpalle; 22 - Sangem; 19 - Bhagamandala; 17 - Mahabaleshwar, Atmakurwrgl, Nallabelly and Castle Rock; 16 - Subramanya,Kottigehara, Zaffergadh, Mulki and Jagalbet; 15 - Lonavala ARG, Sulya, Gersoppa and Matheran; 14 - Mortad, Mani, Armur, Shirali PTO, Ghanpur, Regonda, Shayampet, Parkal,Ambernath and Linganamakki HMS; 13 - Jayapura, Chhamonu, Mulug, Parvathagiri and Karjat ARG; 12 - Bonakal, Peringome AWS, Sanguem, Gaganbawada, SringeriHMS, Palakurthi, Panambur, Dornakal, Mangaluru, MangaluruAP, Puttur HMS, Uppinangadi, Kollur, Chinnakalar and Ponda.

TABLE 8 (*Contd.*)

26 Jul	21 - Castle Rock and Wakwali ARG; 20 - Long Island; 19 - Lakhanmajra REV and Venkatapuram; 18 - Mahabaleshwarand Matheran; 17 - Chiplun, Subramanya, Pen and Samalkha; 16 - Valpoi, Jatton Barrage and Kapkot; 15 - Dapoli ARG, Gaganbawada, Mangaon and Ganjbasoda; 14 -Tala, Panvel ARG, Sanguem and Palghar ARG; 13 - Gohana,Udaipura, Ratnagiri , Nissing REV, Gersoppa, Ambernath, Sudhagad Pali, Roha, Mhasla, Bhopalpatnam and Udupi; 12 -Poladpur, Narsipatnam, Nilokheri, Lonavala ARG, Nuzvid, Mahad, Wada, Renuka/Dadhau and Konta.
27 Jul	62 - Chityal; 47 - Regonda; 46 - Parkal and Ghanpurjskb; 43 Laxmidevipetta – 65 cm Mogullapalle; 37 - Venkatapur; 33 - Mulug and Govindaraopet; 30 - Pen and Shayampet; 29 - Atmakurwrgl,Nanipalson, Hasanparthy, Nallabelly and Jammikunta; 28 - Huzurabad; 26 - Bheemadevarpalle; 25 - Pinapaka and Zaffergadh; 24 - Hanamkonda and Bhupalpalle; 23 - Mahabubabad and Boath; 22 - Lanja, Etawah (CWC) , Colaba, Parvathagiri, Kodakandla and Kothagudem; 21 - Bijapur, Dungargarh, Dharmasagar, Sarangapurnrl, Nirmal, Tala, Khanapur and Chennaraopet; 20 - Narsampet, Sangem, Kothaguda, Murud, Sirpuru, Khammam Urban, Ratnagiri and Palawancha; 19 - Dornakal and Tadwai Mlg; 18 - Garla, Pegadapalle, Ghanpur, Mhasla, Alibag - IMD Part Time, Dharmaram, Bazarhathnoor, Mahabaleshwar and Sultanabad; 17 - Manuguru, Malyal, Gangadhara, Choppadandi, Castle Rock, Shriwardhan, Dapoli ARG, Kathlapur, Mallial, Boinpalle, Harsul - Fmo, Gundala, Shankarapatnam, Elagaid, Aswapuram and Thimmapur; 16 - Gudurwrgl, Mandangad, Srirampur, Subramanya, Raghunathpalle, Julurpad, Dahegaon, Gaganbawada, Yellandu and Nagpur Aerodrome;15 - Mirdoddi, Noothankal, Kammar Palle, Agriculture College, Usoor, Korpana, Enkuru, Sarangapur, Santacruz , Mangaon, Jagtial, Matheran, Chigurumamidy and Hingna; 14 Dummugudem, Ramgundam, Harnai IMD, Chiplun, Sudhagad Pali, Bhadrachalam, Khanpur, Burgampadu, Karimnagar, Jainoor, Tekulapalle, Mancherial, Hinganghat, Kamptee, Madhbun, Dehgam ARG and Metpalle; 13 - Wakwali ARG, Roha, Yellandu (ARG) , Yellareddypeta, Sirsilla, Velagatoor, Selu, Devaruppal, Rajapur, Talamadugu, Utnur, Bheemgal, Bhairamgarh, Laxmanchanda, Venkatapuram, Mulakalapalle, Dandepalle, Palakurthi and Mortad; 12 - Samudrapur, Bhind-aws, Poladpur, Karimnagar AP, Kunavaram, Sangameshwar Devrukh, Jawhar, Kaprada, Palghar ARG, Khanvel, Panvel ARG, Uran, Guhagarh, Julapalle, Balkonda, Tamsi, Luxettipet, Jaipur and Lonavala ARG.
28 Jul	31 - Jawhar and Nanipalson; 30 - Mahuva; 27 - Khanvel, Navsari and Khanpur; 26 - Ozharkheda - Fmo; 25 - Navipet;24 - Mokheda - Fmo; 23 - Vasmat; 21 - Ambernath; 20 - Dahanu , Vasai, Subramanya, Subir and Matheran; 19 - Navasari AWS, Jalalpor, Bardoli, Ardhapur, Nanded – IMD Parttime and Ulhasnagar; 18 - Dharmabad, Kathlapur, Kaprada and Songadh; 17 - Bhiwandi, Gaganbawada, Peth,Umergam, Vapi and Laxmanchanda; 16 - Dangs (ahwa) , Makloor, Mudhole, Rajkishorenagar, Naigaon Khairgaon, Falakata, Bheemgal, Vikramgad, Lanja and Wada; 15 - Bhavnagar, Palsana, Metpalle, Mudholebasar, Poladpur and Thane; 14 - Kalyan, Mounntabu Tehsil SR, Igatpuri, Waghai, Mortad, Ranjal, Khalapur, Mallapur and Murbad; 13 - Vansda,Valod, Choryasi, Pen, Mawsynram, Bhoranj, Dilawarpur, Uran,Vaibhavwadi, Chandurthi, Harsul - Fmo, Nandipet, Dhar Palle,Jakranpalle, Silvassa and Armur; 12 - Kesli, Bhokar, Tondapur- ARG, Kataula, Colaba , Chauldhowaghat, Cherrapunji (rkm) , Cherrapunji, Railmagra SR, Badi, Alirajpur, Jalpaiguri, Santacruz , Karjat ARG, Velpur, Bodeli, Roha, Madhbun and Chouldhuwaghat ARG.
29 Jul	21 - Pasighat AP and Jetpur Pavi; 19 - Kathiwada; 18 - Bajag; 17 - Ambernath, Sama and Birdghat; 16 – Jaipur Tehsil SR and Harabhanga; 15 - Jambughoda and Pendra Road; 13 - Araria and Mahabaleshwar; 12 - Lalsot, Ranganadi Nt Xing and Lambhuaa.
30 Jul	17 - Danta Ramgarh; 16 - Aurangabad; 14 - Mathabhanga; 13 - Latehar Balumat Kvk AWS and Baliguda; 12 – Shilaichak, Atabira and Jujumura.
31 Jul	Nil.
1 Aug	26 - Bhubaneswar AP; 18 - Simdega; 14 - Mahabaleshwar; 13 - Ghatsila, Chandil and Jhalda; 12 - Devendranagar.
2 Aug	39 - Boudhgarh; 36 - Jujumura; 35 - Rairakhol; 30 - Karanjia; 28 - Sharpada; 27 - Birmaharajpur; 26 – Ullund and Thakurmunda; 23 - Athmalik, Binika and Rajkishorenagar; 22 - Agalpur, Joshipur, Phiringia and Khairamal; 21 - Dunguripalli, Sonepur, Baliguda, Phulbani, Sukruli, K Nuagaon and Raruana; 20 - Salebhatta; 19 - Jamda, Telkoi, Kirmira, Kolabira, Kusumi, Madanpur Rampur, Bijepur and Khaira; 18 - Kusmi; 17 - Gaisilet, Ambadola, Jabalpur-aws, Bolangir, Tensa, Swam-patna and Rongo; 16 - Nandigram, Banbasa, Laikera, Oupada, Kantamal, Durgachack, Tarva, Bangamunda and Pallahara; 15 - Keonjhargarh, Kaptipada, Daitari, Banspal, Angul, Bahalda, Bhawanipatna, Barpalli, Umaria-aws, Belgaon, Talcher, Majhgaon, Bhuban, Chandia and Chakapad; 14 - Harabhanga, Komna, Kotagarh, Balasore, Naktideul, Soro,Sihora, Palganj, Amfu Kalimpong and Kumdam; 13 - Chendipada, Bijadandi, Bhograi, Nh 5 Gobindpur, Rajghat, Majholi, Khajuripada, Sohela, Tikabali, Gudvela and Hindol; 12 - Padmapur, Narla, Raikia, Lanjigarh, Ghatagaon, Danagadi, Indus, Joda, Padampur, Kantapada, Loisingha, Basudevpur and Satwas.
3 Aug	24 - Bichhia; 23 - Gohparu; 22 - Dharamjaigarh; 20 - Raipura; 19 - Simariya, Panposh, Kutra and Niwas; 18 - Mawai; 17 - Bilhari, Raurkela, Mandira Dam, Rourkela and Kumdam; 16 - Anuppur-aws, Surajpur, Jabera, Rajgangpurand Umariyapan; 15 - Bakal, Ramanujnagar, Patharia, Venkatnagar, Bargaon, Kurdeg, Jaisingh Nagar, Amarkantak, Pawai and Mohgaon; 14 - Bahoriband, Rithi, Lormi and Binika; 13 - Lailunga, Katni (mudwara) , Sihora, Sleemanabad, Hatta, Devendranagar, Simdega, Nawana, Barela, Ranjhi, Kusmi, Bijadandi and Panagar; 12 -Tendukheda, Dharakote, Lephripara, Bilha, Kartala,Mahabaleshwar, Mungeli, Shahpura, Dheemarkheda and Patera.
4 Aug	28 - Jabera; 22 - Ajaigarh and Bhander; 18 - Narsinghpur- aws; 17 - Orchha, Pipariya and Seodha (seondha) ; 16 - Udaipura, Tamia and Gadarwara; 15 - Sama, Mehadwani, Raipura, Simariya, Kareli and Panna; 14 - Sabroom, Mirganjand Lalitpur; 13 - Mohangarh, Amarpatan, Mau, Bakal, Batiyagarh, Samnapur, Dindori-aws and Gotegaon; 12 - Amanganj, Deori, Dharmsala, Bareli, Pachmarhi, Bijnor and Bankhedi.

TABLE 8 (*Contd.*)

5 Aug	16 - Roan and Mihona; 13 - Lahar, Nowgong, Mathabhangaand Nh 31 Bridge.
6 Aug	21 - Mawsynram; 14 - Sapotra; 13 - Orchha; 12 - Cherrapunji (rkm) .
7 Aug	30 - Mawsynram; 26 - Cherrapunji (rkm) ; 24 - Cherrapunji;19 - Bhaghmara; 17 - Sonamura and Sabroom; 16 - Naina Davi; 15 - Arundhutinagar; 14 - Agartala AP, R L Bbmb, A DNagar AWS and Belonia; 13 - Lembuchhera, Lawngtlai ARG and Mushari; 12 - Itarahi and Champai AWS.
8 Aug	17 - Purnea, Jalalgarh and Chanchal; 16 - Haldwani, Arariaand Raniganj; 15 - Gajole and Harish Chandrapur; 14 -Banmankhi and Mawsynram; 13 - Forbesganj, Kadwa, Lawngtlai ARG and Bamongola; 12 - Narpatganj and Nirmali.
9 Aug	27 - Rupouli and Kotdwara; 26 - Sultanganj; 25 - Mushari; 24 - Haldwani; 23 - Colgaon and Asarganj; 22 - Pirpaiti,Banbasa, Lalbegiaghat and Chakia; 21 - Mawsynram and Tarapur; 20 - Mahedi/Mehshi; 19 - Minapur and Pusa; 18 -Dumri; 17 - Laxmipur and Nainital; 16 - Barari, Muzaffarpur, Sama, Tariyani and Parbatta; 15 - Chanchal and Shambhuganj; 14 - Ahirwalia and Khatima; 13 - Gogri, Sahibganj Kvk AWS, Nirmali, Bariarpur, Raniganj, Bhagalpur,Sonhaula, Amdabad and Loharkhet; 12 - Naugachia, Gaighat, Amfu Kalimpong, Naharkatia ARG, Pantnagar and Mawkyrwat.
10 Aug	43 - Rishikesh; 26 - Chatia; 19 - Uska Bazar Fmo; 16 -Baitunthpur, Nautan and Barauli; 15 - Rewaghat; 14 - Birdghat, Mehdawal and Haripur; 13 - Baltara, Gaighat, Chauldhowaghat and Gorakhpur; 12 - Bhore, Basl Mugaiyur,Bansgaon and Mukhlispur.
11 Aug	21 - Jagadhari; 16 - Bilaspur Sadar and Nadaun; 13 - Una, Birdghat and Chanderdeepghat; 12 - Bansgaon.
12 Aug	14 - Sevoke; 13 - Cherrapunji (rkm) ; 12 - Pudukottai,Cherrapunji and Garubathan.
13 Aug	31 - Mawsynram; 23 - Barpeta; 22 - Mawkyrwat; 21 - Cherrapunji (rkm) ; 19 - Beky Rly.bridge, Garubathan and Cherrapunji; 17 - Sundarnagar and Barpeta/Sarbhog AWS; 15 - Dhubri IMD, Sujanpur Tira and Hazuah; 13 - Gohar, Sarkaghat and Chengmari/Diana; 12 - Dinhata, Kahu, DhubriCWC, Murti, Jalpaiguri, Champasari, Bangana R, Mandi and Bangana F.
14 Aug	42 - Rishikesh; 27 - Kangra AP; 25 - Sujanpur Tira and Dharmsala; 23 - Chuari; 22 - Palampur; 19 - Guler; 18 - Sarkaghat, Jogindarnagar and Nagrota Surian; 17 - Dehra Dun, Bangana R, Kataula, Sundarnagar, Pandoh, Bangana Fand Jollygrant; 16 - Mussoorie; 15 - Tajewala and Baldwara;14 - Mandi, Koratur and Deoprayag; 13 - Dharmshala AWS,Shimla AP, Barthin, Nuagaon and Simla; 12 - Tehri, Berthin Agro, Tirur Kvk AWS, Gohar and Sama.
15 Aug	17 - Long Island; 14 - Gohar; 13 - Sujanpur Tira.
16 Aug	13 - Gossaigaon and Lembuchhera.
17 Aug	12 - Forbesganj.
18 Aug	18 - Rishikesh, Banki and Telkoi; 16 - Lakhnadon; 15 -Jaridih; 14 - Gudvela; 12 - Haripur, Bhandara, Canning, Champua and Pipili.
19 Aug	15 - Tamia and Shahpura; 12 - Keolari, Bhopalpatnam and Takhatpur.
20 Aug	15 - Vidisha, Biaora and Wardha; 13 - Kasarwad and Mulki.
21 Aug	16 - Bagidora SR; 14 - Sajjangarh SR; 13 - Udaipur/D-aero.
22 Aug	17 - Gaighat (Bla Fmo) and Katra; 15 - Patahi and Chauldhowaghat; 14 - Reasi ARG, Reasi Kvk AWS and Forbesganj; 13 - Saraiya and Katerniaghat; 12 – Shahpura, Kathua and Baheri.
23 Aug	23 - Muhammadi; 22 - Barpeta and Chepan; 21 - Beky Rly.bridge, Kahu and Kataula; 20 - Neemsar and Etah; 19 -Sikrai and Milak; 18 - Ayoadhya, Kanpur Teh, Sahaswan, Bareilly CWC, Pandoh, Barthin, Bilaspur Sadar, Sama andBairad; 17 - Mirganj, Talbehat, Kishanganj, Sambhal andDomohani; 16 - Berthin Agro, Dharampur, Kandaghat, Mohitnagar, Amtala and Tamulpur; 15 - Bangana F, Beir SR,Sabalgarh, Barobhisha, Bangana R and Kasauli; 14 -Loharkhet, Vijaypur (adp) , Baldwara and Pawayan; 13 -Melabazar/Matunga, Islampur, Mehre (barsar) , Gunnaur,Jalesar, Naina Davi, Bareilly PBO, Simla, Bhatpurwaghat, Hardoi Teh, Jalpaiguri and Hardoi; 12 - Tangla ARG, Sivakasi,Bilari, Mandi, Pohri, Budaun, Barara ARG and Alipurduar PTO.
24 Aug	19 - Long Island; 16 - Aliganj; 15 - Jogindarnagar and Tangi;14 - Palampur; 13 - Mawsynram; 12 - Ghanshyampur and Sahaswan.

TABLE 8 (*Contd.*)

25 Aug	21 - Bagdogra IAF; 20 - Champasari; 19 - Salbari; 17 - Fatehpur Tehsil; 16 - Forbesganj and Mohitnagar; 15 – Kalka and Singheshwar; 14 - Pandaul, Jalpaiguri and Gajoldoba; 13 - Supaul, Darjeeling, Damthang and Madhipura; 12 - Lalbegiaghat, Tuting, Bhaghmara, Nawabganj Tehsil and Khagadia.
26 Aug	17 - Siswan; 15 - Gaunaha; 14 - Forbesganj; 12 -Lalbegiaghat.
27 Aug	38 - Mawsynram; 29 - Cherrapunji (rkm) ; 25 - Shella; 19 - Mawphlang; 17 - Cherrapunji and Mawkyrwat; 16 - Gaunaha;15 - Nachu ARG; 14 - Birpur; 13 - Forbesganj and Beki Mathungari; 12 - Sikta.
28 Aug	32 - Chengmari/Diana; 25 - Neora; 19 - Rongo and Nagarkata; 18 - Murti, Barpeta ARG and Barpeta/Sarbhog AWS; 16 - Manash Nh Xing; 15 - Mawsynram; 13 - Khliehriat; 12 - Goibargaon, Beky Rly.bridge and Melabazar/Matunga.
29 Aug	36 - Long Island; 14 - Maya Bandar.
30 Aug	15 - Tirupuvanam and Chinnakalar; 13 - Cherthala.
31 Aug	14 - Tirupuvanam; 12 - Rscl-2 Koliyanur.
1 Sep	12 - Hiriyur HMS.
2 Sep	24 - Long Island; 16 - Nlumukku; 15 - Vaigai Dam and Kakkachi; 13 - Ranni AWS; 12 - Lonavala ARG and Shahpur.
3 Sep	20 - Long Island; 16 - Kondapuram; 15 - Koilkuntla; 13 -Khila Ghanpur and Naraj.
4 Sep	21 - Long Island; 15 - Konni, Metpalle and Dich Palle; 13 - Mancompu, Kunnathanam AWS, Mudhole, Armur and Banki; 12 - Kurudamannil, Gandhari, Nirmal and Jakranpalle.
5 Sep	14 - Gandhari, Medchal and Belaguntha; 13 - Suliapada; 12 -Hakimpet IAF and Kondapur.
6 Sep	12 - Balasore.
7 Sep	17 - Vadakara; 16 - Mahe and Similiguda; 15 - Khanvel andSingodi; 13 - Balajipeta; 12 - Urumi AWS and Kondagaon.
8 Sep	21 - Harnai IMD; 17 - Bhiwandi; 16 - Matheran; 15 - Narayanpur and Ambernath; 14 - Ulhasnagar, Waghai and Mokheda - Fmo; 13 - Panvel ARG, Vasai, Shahapur, Palghar ARG and Lonavala ARG; 12 - Karjat ARG, Umerpada, Wadaand Harsul - Fmo.
9 Sep	25 - Dapoli ARG; 19 - Ratnagiri ; 17 - Wakwali ARG and Guhagarh; 16 - Mangaon and Chiplun; 15 - Nandadih, Harsul - Fmo, Harnai IMD, Roha, Trimbakshwar and Orchha; 14 - Jhirnya, Khategaon and Bagli; 13 - Kaprada, Gohparu, Tala,Ozharkheda - Fmo and Soegaon; 12 - Nawadih, Niwari, Kannod, Nepanagar and Subir.
10 Sep	23 - Dholpur Tehsil SR; 17 - Morena-aws; 15 - Banswara SR,Kesarpura SR and Nagina; 14 - Tamia and Mahabaleshwar;12 - Nainital, Sikandra Rao and Barapani.
11 Sep	32 - Fatehpur Tehsil; 31 - Bilaspur; 27 - Bilari; 23 -Moradabad CWC; 22 - Maya Bandar; 21 - Sambhal; 19 - Moradabad; 18 - Nawabganj Tehsil; 17 - Hardoi Teh; 16 - Sahawar, Hathras, Moradabad, Ramnagar and Long Island;15 - Kasganj and Kanpur Teh; 14 - Lucknow (Cr) and Chhibramau; 13 - Asnawar SR, Amaravati, Sahaswan, Lucknow (hs) and Bihubar; 12 - Dhampur, Kasba Tanda, Suar, Gunnaur, Mahsi and Nainital.
12 Sep	27 - Elgin Bridge; 25 - Kaiserganj; 23 - Ramnagar; 21 - Similiguda; 16 - Jeypore; 15 - Papadahandi; 12 – Fatehpur Tehsil and Dharmanagar/Panisagar.
13 Sep	19 - Ambadola; 16 - Lanjigarh; 13 - Daringibadi; 12 – Atabira and Chitrakunda K Guma.
14 Sep	21 - Ambadola and Bolangir; 19 - Madanpur Rampur; 18 - Alipingal, Jagatsinghpur and Kotagarh; 16 - Th Rampur andKantamal; 15 - Tirtol and Kendrapara; 14 - Dabugan; 13 - Dahegaon, Kendrapada PTO, Kotraguda, Vemanapalle, Raghunathpur and Khajuraho AP; 12 - Narla, Lanjigarh, Phiringia, Balikuda, Mawai and Danagadi.
15 Sep	24 - Paraswada and Barghat; 21 - Waraseoni; 19 - Deogaon;18 - Sanawad and Bijnor; 17 - Lakhnadon, Kirnapur, Kurai and Malanjkhand; 16 - Katangi, Chhapara, Champa and Tirodi; 15 - Lalburra, Bilaigarh, Birsa, Seoni and Kashdol; 14 - Bilaspur, Baihar and Balaghat-aws; 13 - Gudvela; 12 - Gondia AP, Pushprajgarh, Sahaspurlohara, Labhandih and Gondia.

TABLE 8 (*Contd.*)

16 Sep	45 - Bhimpur; 35 - Bhainsdehi; 29 - Rahatgaon; 27 - Sonkatch and Chicholi; 26 - Maheshwar, Bajna and Depalpur;24 - Pachmarhi, Nagda and Pithampur; 21 - Badnagar, New Harsud, Shahpur and Multai; 20 - Chikhalda, Betul, Sausar, Bareli and Khirkiya-arg; 19 - Seoni Malwa; 18 - Kasarwad,Narmadapuram, Sanwer and Gautampura; 17 - Harda, Hatpiplaya, Alot, Amla, Udainagar, Indore and Bhikangaon;16 - Dug, Barod, Chauri, Bagli, Tamia, Gogawan, Punasa Dam, Hatod, Timarni and Mhow; 15 - Raoti, Pirawa, Mahidpur, Parasia, Atner, Prabhat Pattan, Chand, Petlawad, Kannod and Barwaha; 14 - Umreth, Dharmasthala, Tendukheda, Jharda, Jawar, Kesarpura SR, Budhni, Dhar-awsand Shamgarh; 13 - Rehti, Ghamroor, Satwas, Badnawar, Khalwa, Bakani SR, Junnardeo, Khargone-aws, Sanawad, Sailana and Kottigehara; 12 - Ujjain-aws, Pipariya, Udaipura, Sangrur, Godadongri, Nasrullahganj and Agar. Khandwa 13.5
17 Sep	37 - Bagidora SR; 34 - Kathiwada; 32 - Jabot and Meghnagar; 30 - Dhar-aws and Alirajpur; 29 - Thandla; 28 -Bajna, Sajjangarh SR and Udaigarh; 27 - Sallopat SR, Badnawar, Shergarh SR and Bhabhra; 26 - Sardarpur and Raoti; 25 - Morva Hadaf, Milak, Kesarpura SR and Chhota Udepur; 24 - Jhabua-aws, Dahod, Ratlam-aws and Shahera;23 - Wanakbori; 22 - Pithampur, Rama, Gandhwani, Dahod Kvk AWS, Bagh and Banswara SR; 21 - Dharampuri Tappa, Danpur, Petlawad and Sailana; 20 - Bayad ARG, Ghatol, Ranapur, Limkheda and Bhungra SR; 19 - Mhow, Piploda andGodhra; 18 - Barwaha, Tal, Nisarpur, Garbada, Khushalgarh, Lunawada and Maheshwar; 17 - Manawar, Umarvan, Tirla andBhikangaon; 16 - Hatod, Jambughoda, Khandwa, Kasarwad and Sanawad; 15 - Fatepura, Jhalod, Pipalkhunt SR, Thikri, Depalpur, Santrampur, Virpur and Indore; 14 - Badnagar, Jetpur Pavi, Mounntabu Tehsil SR, Anjad, Nalchha and Bagli; 13 - Nagda, Tindivanam, Bodeli, Dhansura, Bayad, Khachrod, Gautampura, Hatpiplaya, Devgadh Baria, Rajpur, Gogawan, Chachariyapati, Punasa Dam, Kukshi and Singvad; 12 -Pehowa, Sanwer, Balasinor, Jaora, Galiakot SR and Shegaon.
18 Sep	24 - Godhra; 23 - Virpur and Shahera; 21 - Talod, Bayad, Bayad ARG and Nithuwa SR; 20 - Dhansura; 18 - Morva Hadaf; 17 - Prantij and Lunawada; 16 - Kapadvanj and Pratapgarh; 15 - Mahudha, Limkheda, Balasinor, Hut Bay and Kadi; 14 - Kathalal and Wanakbori; 13 - Pambar Dam, Kalasapakkam, Sundergarh, Nadiad, Mansa, Meghraj andMounntabu Tehsil SR; 12 - Kallakurichi, Dahegam, Uthangarai, Bajna, Singrauli-aws and Bhungra SR.
19 Sep	30 - Visavadar; 19 - Radhanpur and Mendarda; 17 - Bhabharand Becharaji; 16 - Mahesana; 15 - Vanthali and Amb; 14 -Dehra Gopipur.
20 Sep	18 - Khowang; 17 - Lakhpat and Koraput; 14 - Nandapur; 12- Rapar and Mawsynram.
21 Sep	18 - Haldwani; 17 - Lormi; 15 - Manash Nh Xing and Panbari;14 - Bilha; 13 - Nainital, Dharchula, Tenughat, Buxaduar, Bahalpur and Chottabekra; 12 - Karanjia, Sinapali, Neora and Dholai.
22 Sep	27 - Chanchal; 19 - Sabour; 17 - Kunnamkulam AWS; 16 - Jamui; 15 - Gogri, Chandrapur, Shambhuganj, Bausi and Ashta-aws; 14 - Gangapur; 13 - Sultanganj and Mawkyrwat;12 - Bhagalpur, Kursela, Parkal, Sahibganj Kvk AWS, Mawsynram, Harish Chandrapur, Simga and Godda.
23 Sep	32 - Kodawanpur/C.b Ii; 29 - Rosera; 27 - Hasanpur; 25 - Baheri; 21 - Samastipur; 20 - Zunheboto; 18 - Mannarkkad,Pusa and Cheria B.pur 1; 17 - Durg; 16 - Agriculture Collegeand Mahanar; 15 - Patepur, Simga, Kusheswarstan, Biaora,Gorantla and Mannarkkad AWS; 14 - Vaishali, Mahua, Tantloi,Hajipur, Igatpuri, Mushari, Suryagadha and Bakhari; 13 - Kartala, Nachu ARG, Haldibari, Kharsiya, Waraseoni andSaraiya; 12 - Bagrakote, Nagpur Aerodrome, Nawada, Chanan, Champa and Patori.
24 Sep	48 - Itahar; 31 - Banshihari; 29 - Kushmundi and Basua; 28 Gajole; 23 - Singheshwar and Hemtabad; 22 - Supaul; 21 -Islampur, Raiganj, Barari and Kaliaganj; 20 - Gangarampur; 19 - Sonbarsa; 18 - Chanchal, Raiganj PTO and Raniganj; 17 Kishanganj, Karandighi and Nirmali; 16 – Harish Chandrapur, Khirkiya-arg, Chas ARG, Bahargama, Salakhua,Amaur and Araria; 15 - Sikti, Kursela, Barsoi and Jokihat; 14 Forbesganj, Tribeniganj, Malda, Chargharia, Mohitnagar andMarauna; 13 - Tiruttani, Kumarganj, Maya Bandar, Manvat, Rahghopur, Ghosi and Narmada Kvk AWS; 12 - Mathabhanga,Chuda, Jalalgarh, Pirpaiti and Tapan.
25 Sep	19 - Hut Bay; 18 - Banshihari; 17 - Haldibari and Cooch Behar; 15 - Rajpipala and Udainagar; 13 - Nandod, Amfu Pundibari and Kaliaganj; 12 - Gudiyatham.
26 Sep	Nil.
27 Sep	13 - Gaganbawada.
28 Sep	15 - Port Blair; 13 - Lanja; 12 - Kvk Kattukuppam ARG.
29 Sep	15 - Cherthala AWS and Long Island; 13 - Cherthala; 12 -Thycauttussery AWS, Vadakkancherry, Iaf Carnicobar, Dabolim N.a.s.-Navy, Kumarakam and Kusmi.
30 Sep	13 - Ernakulam South and Mapusa.

4. **Extra Indian features**

4.1. *Cross Equatorial Flow during June - September 2023*

(a) *Over the Arabian Sea*

		5° N - 5° S				North of 5° N				
		Weeks				Weeks				
Month	Normal (in knots)	1	2	3	4	Normal(in knots)	1	2	3	4
Jun	10-12	**0**	**-2**	**+2**	**+2**	15-20	**-2**	**0**	**0**	**0**
Jul	12-14	**+1**	**0**	**+1**	**+3**	20-25	**0**	**0**	**-1**	**+5**
Aug	12-14	**+5**	**+2**	**+4**	**0**	20-25	**-2**	**0**	**-6**	**-4**
Sep	08-10	**+2**	**+4**	**+4**	**0**	05-10	**+7**	**+7**	**+6**	**+2**

The Cross-Equatorial flow along the equatorial belt (equator to 5° N/ 5° S) over Arabian Sea was :

(*i*) During June 2023, it was normal during 1st week while it was below normal during 2nd week and strength of cross equatorial flow was above normal during 3rd and 4th week.

(*ii*) During July 2023, it was normal during 2nd week while it was above normal during 1st week, 3rd week and during 4th week.

(*iii*) During August 2023, it was normal during 4th week while it was above normal during 1st, 2nd and 3rd week.

(*iv*) During September 2023, it was normal during 4th week. while it was above normal during 1st, 2nd and 3rd week.

The surface winds over Arabian Sea to the north of 5° N were:

(*i*) During June 2023, it was below normal during 1st and 2nd week while it was above normal during 3rd week and during 4th week.

(*ii*) During July 2023, it was above normal during 1st and 2nd week while it was below normal during 3rd and above normal during 4th week.

(*iii*) During August 2023, it was above normal during 2nd week while it was below normal during 1st, 3rd and 4th week.

(*iv*) During September 2023, it was above normal in all weeks.

Over the Bay of Bengal

		5° N - 5° S				North of 5° N				
		Weeks				Weeks				
Month	Normal (in knots)	1	2	3	4	Normal(in knots)	1	2	3	4
Jun	08-10	**+4**	**+3**	**+3**	**+4**	10-15	**+1**	**+2**	**+1**	**0**
Jul	08-10	**+3**	**+4**	**+5**	**+5**	10-15	**-1**	**0**	**+2**	**+2**
Aug	08-10	**+6**	**+5**	**+5**	**+6**	10-15	**0**	**0**	**0**	**0**
Sep	08-10	**+8**	**+5**	**+3**	**0**	05-10	**+6**	**+3**	**0**	**0**

The Cross Equatorial flow along the equatorial belt (equator to 5° N/5° S) over Bay of Bengal was:

(*i*) During June 2023, it was above normal in all weeks.

(*ii*) During July 2023, it was above normal in all weeks.

(*iii*) During August 2023, it was above normal in all weeks.

(*iv*) During September 2023, it was normal in 4th week while it was above normal 1st, 2nd and 3rd week.

The surface winds over the Bay of Bengal to the north of 5° N were :

(*i*) During June 2023, it was normal during 4th week while it was above normal during 1st, 2nd and 3rd week.

(ii) During July 2023, it was normal during 2nd week while it was below normal during 1st week and it was above normal 3rd and 4th week.

(iii) During August 2023, it was normal in all weeks.

(iv) During September 2023, it was normal during 3rd and 4th week while it was above normal during 1st and 2nd week.

4.2. *Position of Equatorial Trough was*

June 2023 : North of its normal position by 1° - 2 °, to the West of 93° E and 1° - 6 ° from 93° E to 110° E during first week. South of its normal position by 2° - 5 ° from 40° E to 90° E and South of its normal position by 3° - 5°, from 92° E to 110° E during the 2nd week. North of its normal position by 1° - 2° from 40° E to 85° E and South of its normal position by 2° - 7° during the 3rd week. North of its normal position by 1° - 2° from 40° E to 59° E and South of its normal position by 2° - 5°, from 59° E to 110° E during the 4th week.

July 2023 : North of its normal position by 1°, from 40° E to 54° E and South of its normal position by 1° - 8 ° from 63° E to 110° E during the first week. South of its normal position by 1° - 3° from 40° E to 80° E and South of its normal position by 3° - 8° from 80° E to 110° E during the 2nd week. South of its normal position by 2° - 3° from 40° E to 80° E and South of its normal position by 3° - 5° from 86° E to 110° E during the 3rd week. It was South of its normal position by 2° - 3° from 40° E to 75° E and North of its normal position by 1° - 2 ° from 75° E to 110° E during the 4th week.

August 2023 : It was South of its normal position by 1° - 5° from 40° E to 53° E and North of its normal position by 1° - 4° from 53° E to 110° E during the first week. North of its normal position by 1° from 40° E to 60° E and South of its normal position by 1° - 6° from 61° E to 110° E during the 2nd week. North of its normal position by 1° from 40° E to 47°, South of its normal position by 1° - 3° from 47° E to 60° E and North of its normal position by 1° - 2° from 80° E to 110° E during the 3rd week. North of its normal position by 1° - 2° from 40° E to 110° during the 4th week.

September 2023 : - North of its normal position by 1° from 40° E to 90° E and South of its normal position by 1° - 4° from 90° E to 110° E in first week. South of its normal position by 1° - 3° from 40° E to 80° E, North of its normal position by 1° - 2° from 80° E to 93° E and South of its normal position by 2°- 3° from 93° E to 110° E during the 2nd week. South of its normal position by 1° - 2° from 40° E to 75° E, North of its normal position by 1° - 2 ° from 75° E to 95° E and South of its normal position by 2° - 4° from 95° E to 110° E during the 3rd week. North of its normal position by 1° - 2° from 40° E to 110° E during the 4th week.

4.3.a *Low Pressure Systems during June to September 2023 in Bay of Bengal*

Low Pressure Systems	Jun	Jul	Aug	Sep	Total
Low Pressure Area / WML	02*	03	01	04	10
Depression	00	00	00	00	00
Deep Depression	00	00	01	00	01
Tropical Storm (T.S.)	00	00	00	00	00
Total	02	03	02	04	11

* Low pressure area over land.

4.3.b *Low Pressure systems during June to September 2023 in Arabian Sea*

Low Pressure Systems	Jun	Jul	Aug	Sep	Total
Low Pressure Area / WML	00	00	00	00	00
Depression	00	00	00	01	01
Deep Depression	00	00	00	00	01
Tropical Storm (T.S.)	01	00	00	00	00
Total	01	00	00	01	02

4.3.c *Low Pressure Systems over the West Pacific Ocean/ South China sea*

There were in all, 12 low pressure systems (reaching the intensity of Tropical depression and above) over the northwest Pacific Ocean / South China Sea during June - September 2023. The month wise distribution is given below:

Systems	Jun	Jul	Aug	Sep	Total
Low Pressure Systems	00	00	00	00	00
Tropical Depression (T.D.)	00	00	00	01	01
Tropical Storm (T.S.)	01	00	00	03	04
Typhoon/Super Typhoon	01	02	04	01	08
Total	02	02	04	05	13

4.3.d *Low Pressure Systems in South Indian Ocean*

No lowpressure system (TD, TS, Typhoon) was reported in Southern Hemisphere during June-Sept 2023.

4.4. *Troughs in Westerlies affecting the Indian region: to the south of 30° N and to the north of 30° S during June to September 2023.*

4.4.1. *The Upper air troughs in mid and upper tropospheric Westerly over Indian region:*

The month wise details of the number of troughs in westerlies which moved across Indian region from west to east and penetrated to the south of 30° N are given below:

Atmospheric Level	Jun	Jul	Aug	Sep	Total
500 hPa	04	5	7	3	19
300 hPa	04	6	4	5	19

4.4.2. *Upper Air Troughs in westerlies over South Indian Ocean, which penetrate to the north of latitude 30° S.*

The month wise details of the number of troughs in upper air westerlies in the Southern Hemisphere, during June to September 2023, that moved across the South Indian Ocean from west to east and penetrated to the north of Lat. 30° S, are given below:

Atmospheric Level	Jun	Jul	Aug	Sep	Total
500 hPa	04	06	07	04	21
300 hPa	04	07	06	05	22

(*Source: INOSHAC/CONSTANT PRESSURE MAPS, USA*)

4.4.3. Normal position of Mascarene HIGH is centered at 30° S/ 50° E and Australian HIGH is centered at 30° S/ 140° E during June to September 2023.

(**Source: Climatic Atlas of The Indian Ocean)*

The monthwise intensity of Mascarene HIGH which was centered at its mean position of Lat. 32.4° S and Long 55.2° E during June, July, August and September is as follows:

Month	*Normal Pressure (hPa) (approx.)	Actual Pressure (hPa)	Departure from normal hPa (approx.)
Jun	1023.0	1024.3	+1.3
Jul	1025.5	1028.6	+3.1
Aug	1026.0	1031.5	+5.5
Sep	1023.5	1028.7	+5.2

(**Source* : *ACMAD, NOAA*)

The Mascarene HIGH with its mean position at 32.4° S / 55.2 E was strengthened by 5.5 hPa during the month of August 2023. It was above normal by 1.3, 3.1, 5.5 & 5.2 hPa during the months of June, July, August and September 2023 respectively.

4.4. *The monthwise intensity of Australian HIGH which was centred with its Mean position at Lat. 32.7° S and Long 141.9° E. during June to September 2023 is as follows:*

(Month	*Normal Pressure (hPa) (approx.)	Actual Pressure (hPa)	Departure from normal hPa (approx.)
Jun	1022.0	1024.0	+2.0
Jul	1022.0	1030.3	+8.3
Aug	1020.5	1030.6	+10.1
Sep	1018.0	1029.1	+11.1

(**Source* : NOAA)

The Australian HIGH centered at 32.7° S / 141.9.0° E was strengthened by an average of about 11.1 hPa during the month of September 2023. It was above normal by 2.0, 8.3, 10.1 and 11.1 hPa in the month of June, July, August and September 2023 respectively.

5. Semi-permanent systems

5.1. *Heat Low*

The monthwise lowest and the second lowest values at the centre of Heat Low were:

June : 992 hPa (on 16 and 30) and 994 hPa (on 17,18, 21, 22, 25 and 30)

July : 992 hPa (on 1) and 994 hPa (on 2,5,19 and 25)

Aug : 994 hPa (on 1, 2, 3, 7, 8 and 23), 996 hPa (4, 13, 14, 24, 25 and 26)

Sep : 998 hPa (18) and 1000 (4,9,10,11,12 and 25)

5.2. *Monsoon Trough*

During the month of June, the Heat trough was established over the Indo-Gangetic plains during the last week of the month after the dissipation of the ESCS. During July, the Monsoon Trough was mainly positioned south of its normal location for the majority of the days, particularly during the second half of the month. For a few days during 6-19 July, the western end of the monsoon trough was to the south of its normal position and eastern end to the north of its normal position. During August, it remained

primarily situated to the north of its normal position or close to the foothills of the Himalayas, throughout the month. During September, the Monsoon Trough initially lay close to the foothills of the Himalayas then the western end of the trough remained at the foothills of Himalayas while the eastern end moved to the normal or south of its normal position. From the second week onwards, the trough lay to the south of its normal position for most of the days till the end of the month.

5.3. *Tibetan Anticyclone/High*

During 2023, the Tibetan anticyclone was observed to be to the southeast of its normal position during June. It shifted westwards during the second fortnight of July and remained to the west/north west of its normal position. From 21st August, it shifted to the northwest of its normal position and remained to the north of its normal position till the end of August, when it shifted to its normal position. During September, it remained to southwest of its normal position.

5.4. *Tropical Easterly Jet (TEJ)*

The TEJ got established over the southern peninsular India by 7 June with Chennai reporting easterlies of 61 knots at 119 hPa level. A latitudinal spread of the easterly jet speed winds was observed between 8° N to 18° N during June and September, while during July and August 8 to 22° N. During August the core of TEJ was located over further northern latitudes for a few days. The highest wind speed of 136 knots was recorded over Karaikal on 20 July at 113 hPa.

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

The STWJ shifted northwards from the second week of July, Srinagar reported 80 knots wind (at 201 hPa) at 0000 UTC of 10 July. Subsequently, the core of STWJ shifted to the north of the Himalayas. It once again shifted southwards as evident by the 78 knots westerly wind reported over Srinagar at 147 hPa on 25 August (0000 UTC) and again on 10 September 87 knots at 208 hPa. over Srinagar.

6. Other features

6.1. *Monthly wind anomalies during Southwest Monsoon 2023*

The circulation anomaly features at lower, middle and upper tropospheric levels, 850, 700, 500 and 200 hPa during the southwest monsoon season are discussed below:

6.1.1. *June wind anomaly features*

In the monthly wind pattern, an anomalous cyclonic circulation was seen over east Uttar Pradesh from 850 hPa to 500 hPa. An anomalous ridge at 200 hPa extended along 8° N.

During the week ending 7 June, anomalous ridge was seen from 850 hPa, over central India extending upto 500 hPa, indicating weaker than normal monsoon circulation over the region.

During the week ending 14 June, an anomalous anticyclone was seen at 850 hPa over Rayalaseema and neighbourhood, extending upto 700 hPa. One anomalous cyclonic circulation was observed over Northeast Arabian sea at 850 hPa extending upto 500 hPa.

During the week ending 21 June, two anomalous cyclonic circulations were observed over northeast Arabian sea adjoining Gujarat coast and another over Delhi region from 850 hPa to 700 hPa.

During the week ending 28 June, two anomalous cyclonic circulations were observed over west Madhya Pradesh and the second over Odisha both extending from 850 hPa to 300 hPa. An anomalous ridge at 200 hPa extended along 33° N.

6.1.2. *July wind anomaly features*

In the monthly wind pattern two anomalous cyclonic circulations were observed one over Konkan & Goa and the other over coastal Andhra Pradesh from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 24° N.

During the week ending 5 July, four anomalous cyclonic circulations were seen one over northwest Madhya Pradesh from 850 hPa to 700 hPa, second near West Madhya Pradesh, third over Rayalaseema at 850 hPa and the fourth over central Bay of Bengal from 850 hPa to 500 hPa. A ridge at 200 hPa extended along 23° N.

During the week ending 12 July, an anomalous cyclonic circulation was seen from 850 hPa to 700 hPa over west Madhya Pradesh and adjoining Gujarat. At 700 hPa two cyclonic circulations, was seen, one over southwest Bay of Bengal and the other over northeast Arabian sea and adjoining Gujarat. A ridge at 200 hPa extended along 27° N.

During the week ending 19 July, one anomalous trough was seen from east Rajasthan to Odisha was seen from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 32° N.

During the week ending 26 July, an anomalous trough was seen from Gujarat to west central Bay of Bengal adjoining coastal Andhra Pradesh from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 14° N.

6.1.3. *August wind anomaly features*

During August, the monthly wind pattern shows an anomalous anti cyclonic circulation over east central Arabian sea and adjacent area with a ridge extending from it to central Bay of Bengal from 850 hPa to 300 hPa and a ridge at 200 hPa extending along 29° N.

During the week ending 2 August, an anomalous cyclonic circulation was observed over west central Bay of Bengal adjoining east central Bay of Bengal extending from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 18° N.

During the week ending 9 August, an anomalous ridge was seen from 850 hPa to 300 hPa, from northeast Arabian sea to Andaman sea.

During the week ending 16 August, an anomalous ridge was seen over central India along 20° N from 850 hPa to 300 hPa. An anomalous ridge at 200 hPa extended along 33° N.

During the week ending 23 August, an anomalous ridge was observed over approximately 25° N from 850 hPa to 300 hPa. An anomalous ridge at 200 hPa extended along 32° N.

In the week ending 30 August, an anomalous ridge was observed over approximately 18° N from 850 hPa to 300 hPa A ridge at 200 hPa extended along 16° N.

6.1.4. *September wind anomaly features*

The monthly wind pattern during September shows an anomalous trough from Rajasthan to head Bay of Bengal and cyclonic circulation over West Rajasthan and neighbourhood extending upto 300 hPa tilting southwards with height at 850 hPa level and a ridge at 200 hPa extending along 28° N.

During the week ending 6 September, one anomalous trough was observed over south peninsula from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 12° N.

During the week ending 13 September, an anomalous trough was seen approximately at 25° N from 850 hPa to 300 hPa. A ridge at 200 hPa extended along 27° N.

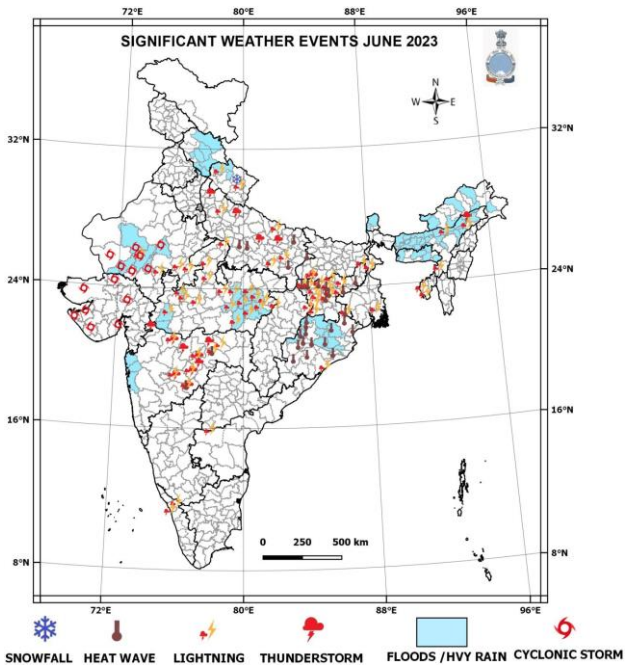
During the week ending 20 September, a trough was seen from south Rajasthan to head Bay of Bengal extending from 850 hPa up to 500 hPa tilting southwards with height. A ridge at 200 hPa extended along 26° N.

During the week ending 27 September, three anomalous cyclonic circulations were seen at 850 hPa, one over north Gujarat and adjoining Pakistan and the second over northeast Madhya Pradesh and a trough passing through them and the third anomalous cyclonic circulation was observed over Punjab. A ridge at 200 hPa extended along 27° N.

7. Disastrous weather events and damage during Monsoon months

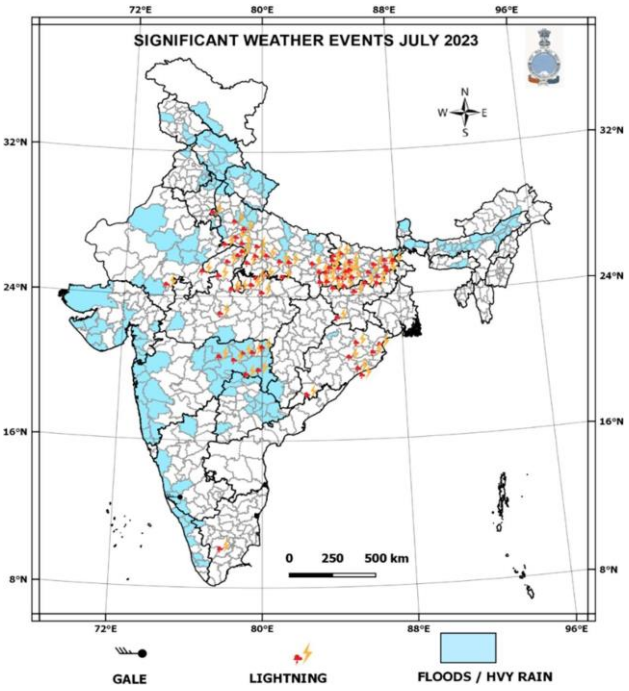
7.1. *June*

As per media reports, total 286 persons were reported dead, 170 persons were injured and 2235 livestock perished during June, because of various weather-related incidents (Based on real time media reports.). 112 persons were reported dead during June, because of Heat Wave.



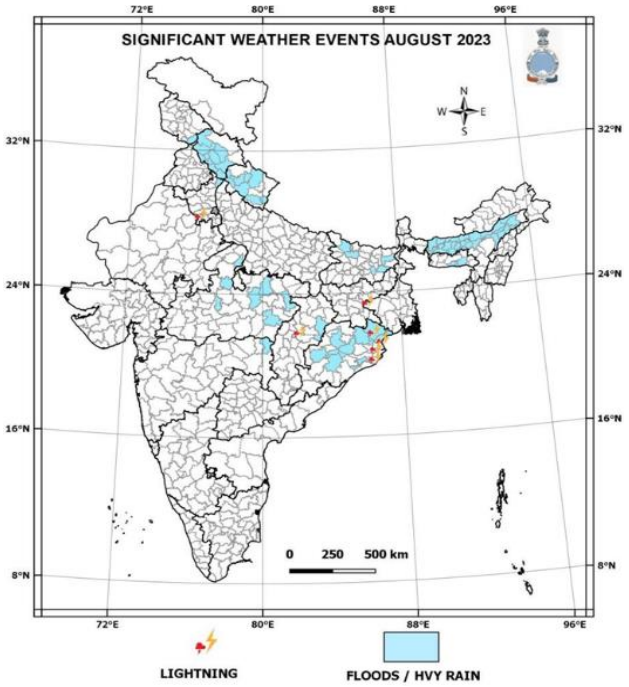
7.2. *July*

During July, total 420 persons were reported dead, more than 95 persons were injured, more than 55 persons missing and more than 40 livestock perished due to various severe weather events. Out of this, as per media data, a total around 170 persons were reported dead, 46 persons were injured and more than 20 livestock perished during July, because of Lightning.



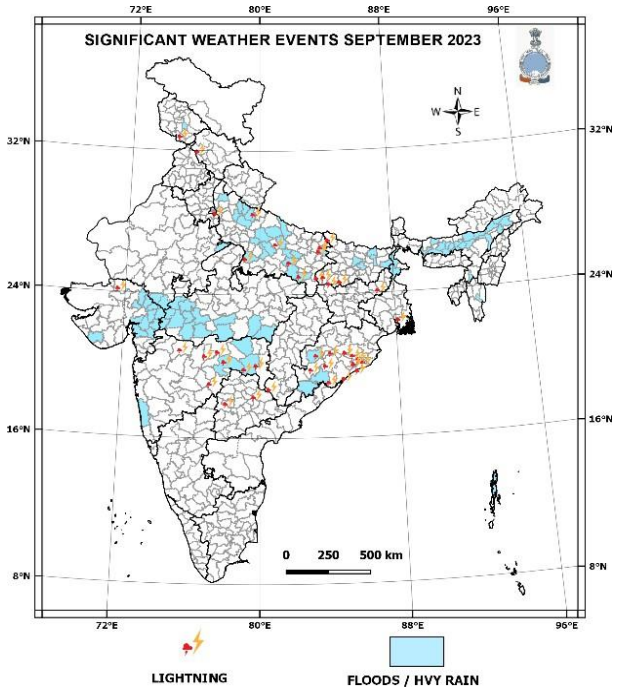
7.3. *August*

During August, total 149 persons were reported dead, 40 persons injured, 50 persons missing and some livestock perished due to various weather events. The details of causalities given below, which are based on real time media reports.



7.4. *September*

During September, totally 89 persons were reported dead, more than 50 persons injured & more than 95 livestock perished due to various weather events Figure below shows significant weather events during the month of September.



The inputs from the offices of India Meteorological Department, *viz*., (*i*) Director General of Meteorology (Hydromet), New Delhi and (*ii*) Climate Monitoring and Analysis Group, Climate Research Division, Pune are gratefully acknowledged. Thanks are due to Smt. P. P. Kulkarni for her assistance in preparation of the manuscript.

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Appendix

Definition of the terms given in '*Italics*'

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

Monthly/seasonal rainfall distribution on sub-division scale

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 % or less
No rain	-	–100%

Rainfall distribution on All India scale

Below Normal	-	percentage departure from normal rainfall is from <10 %
Normal	-	percentage departure from normal rainfall is from +10 % to –10 %
Above Normal	-	percentage departure from normal rainfall is from >10 %

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 cms along the west coast and 5 cms elsewhere in at least two stations in the sub-division