MAUSAM, **74**, 4 (October 2023), 1199-1220

MAUSAM

Homepage: https://mausamjournal.imd.gov.in/index.php/MAUSAM

Weather in India

POST MONSOON SEASON (October-December 2022)†

1. Introduction

Post monsoon season 2022 witnessed the formation of five intense low pressure systems in the north Indian ocean (NIO) comprising of the Bay of Bengal and the Arabian sea, *viz.*, the Cyclonic Storm, "Sitrang" in October, a Depression in November, Severe Cyclonic Storm "Mandous", one Deep Depression and Depression each in the month of December. All these systems formed in the Bay of Bengal except for the Deep Depression which formed over the Arabian Sea after the remnant of the Severe Cyclonic Storm gradually intensified after re-entering the sea.

The southwest monsoon withdrew from the entire country with a delay of 8 days on 23rd October 2022, (normal date 15th October) and the northeast monsoon season commenced over the southern peninsula on 29th October and ceased on 12th January 2023. Northeast monsoon rainfall over the five core regions was: *excess* in Rayalaseema (122% of L.P.A.) and South Interior Karnataka (151% of L.P.A.) while *normal* in Kerala & Mahe (97% of L.P.A.), Tamil Nadu, Puducherry & Karaikal (101% of L.P.A.) and Coastal Andhra Pradesh & Yanam (106% of L.P.A.).

As a whole the mean temperature for the Post-Monsoon season over the country was the 5th highest (23.76 °C with an anomaly of 0.52 °C) since 1901. Over East & Northeast India, the maximum temperature was the 2nd highest (28.69 °C with an anomaly of 1.10 °C) after the year 2016 (28.77 °C) and mean temperature (22.65 °C with an anomaly of 0.91 °C) was the highest since 1901. The minimum temperatures were above normal over most parts of the country except some parts of Northwest India (Haryana, Chandigarh & Delhi), East & Northeast India, Central India, Southern Peninsular India. *Severe cold wave / cold wave conditions* were observed only in the last fortnight of December over parts of Northwest India in the meteorological sub divisions of Punjab, Haryana, Chandigarh, Delhi and Rajasthan.

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

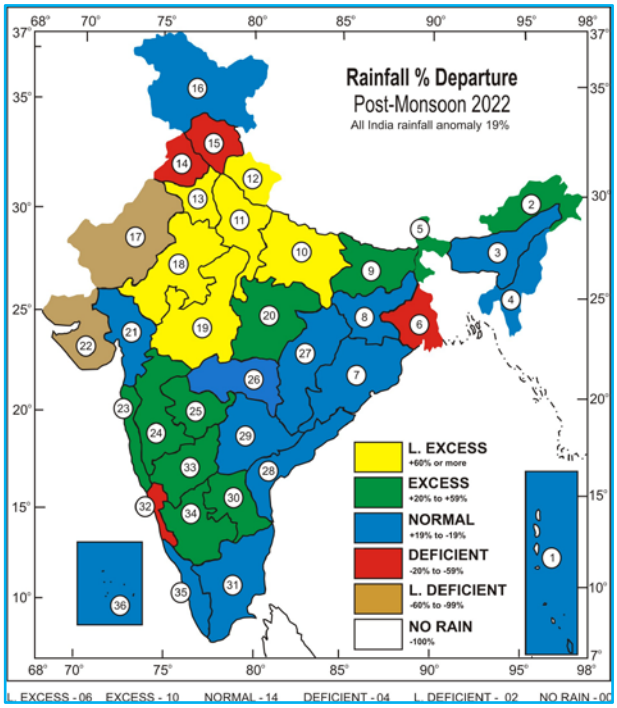


Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for post monsoon season (October to December, 2022). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	-1	**7**	-11	**13**	91	**19**	123	**25**	39	**31**	1
2	49	**8**	3	**14**	-54	**20**	58	**26**	15	**32**	-26
3	19	**9**	22	**15**	-23	**21**	14	**27**	-2	**33**	28
4	-18	**10**	253	**16**	-10	**22**	-77	**28**	6	**34**	51
5	21	**11**	366	**17**	-71	**23**	22	**29**	-4	**35**	-3
6	-38	**12**	118	**18**	166	**24**	56	**30**	22	**36**	-10

Moderate to Dense fog was observed in the last week of November and first fortnight of December over most sub divisions of north India. Dense to very dense fog prevailed over the homogenous regions of Northwest India and East & Northeast India during the last fortnight of the season. Very dense fog was observed over Tamil Nadu, Puducherry & Karaikal on one day, while moderate

†*Compiled by* : A. Kashyapi, S.D. Sanap, P. R. Abhang and Jyoti Sonar, Weather Forecasting Division, Pune – 411 005, India

TABLE 1

Sub-divisionwise rainfall (mm) for each month and season as a whole (October-December, 2022)

S. No.	Meteorological Sub-divisions	October			November			December			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A. & N. Islands	319.5	284.6	12%	178.5	238.8	-25%	168.9	147.1	15%	666.9	670.5	-1%
2.	Arunachal Pradesh	335.5	169.7	98%	0.9	41.6	-98%	23.0	30.2	-24%	359.4	241.5	49%
3.	Assam & Meghalaya	221.2	153.1	44%	0.3	26.6	-99%	4.8	10.4	-54%	226.2	190.1	19%
4.	Naga., Mani., Mizo. and Tri.	151.9	150.7	1%	0.7	38.2	-98%	9.6	10.2	-5%	162.3	199.1	-18%
5.	Sub-Himalayan West Bengal & Sikkim	199.8	142.7	40%	1.8	14.9	-88%	1.5	10.7	-86%	203.1	168.3	21%
6.	Gangetic West Bengal	109.1	135.3	-19%	0.0	21.1	-100%	0.2	18.6	-99%	109.3	175.0	-38%
7.	Orissa	123.8	112.0	11%	1.7	22.1	-92%	0.3	6.7	-95%	125.8	140.8	-11%
8.	Jharkhand	91.4	73.4	25%	0.0	8.8	-100%	0.3	6.9	-96%	91.7	89.1	3%
9.	Bihar	81.8	57.2	43%	0.0	4.8	-100%	0.1	5.1	-98%	81.9	67.1	22%
10.	East Uttar Pradesh	149.4	33.6	345%	0.0	3.3	-100%	0.1	5.4	-98%	149.5	42.3	253%
11.	West Uttar Pradesh	139.9	20.7	576%	0.5	3.5	-87%	0.0	5.9	-100%	140.4	30.1	366%
12.	Uttarakhand	117.6	31.0	279%	2.0	6.4	-69%	0.1	17.6	-99%	119.7	55.0	118%
13.	Haryana, Chandigarh & Delhi	36.8	9.6	283%	0.2	3.7	-93%	0.0	6.1	-99%	37.1	19.4	91%
14.	Punjab	9.1	8.1	13%	1.4	5.1	-72%	0.4	10.9	-96%	11.0	24.1	-54%
15.	Himachal Pradesh	38.0	25.1	51%	19.5	19.7	-1%	6.4	38.1	-83%	63.9	82.9	-23%
16.	Jammu & Kashmir and Ladakh	39.8	33.1	20%	61.5	35.2	75%	13.2	59.4	-78%	114.5	127.7	-10%
17.	West Rajasthan	3.0	7.6	-61%	0.5	3.0	-83%	0.0	1.5	-100%	3.5	12.1	-71%
18.	East Rajasthan	67.1	15.0	347%	1.9	7.6	-75%	0.0	3.3	-100%	69.0	25.9	166%
19.	West Madhya Pradesh	100.9	29.5	242%	0.0	10.6	-99%	2.9	6.4	-54%	103.8	46.5	123%
20.	East Madhya Pradesh	87.1	36.6	138%	0.0	10.9	-100%	0.8	8.2	-91%	87.9	55.7	58%
21.	Gujarat Region	37.0	22.1	68%	0.0	9.1	-100%	0.2	1.6	-85%	37.3	32.8	14%
22.	Saurashtra & Kutch & Diu	6.4	18.1	-64%	0.2	9.7	-98%	0.0	0.8	-99%	6.7	28.6	-77%
23.	Konkan & Goa	168.6	116.4	45%	2.2	21.0	-89%	0.9	3.3	-73%	171.7	140.7	22%
24.	Madhya Maharashtra	159.1	77.9	104%	0.4	21.3	-98%	1.5	4.3	-64%	161.0	103.5	56%
25.	Marathawada	132.1	74.0	79%	0.0	17.7	-100%	2.1	5.0	-59%	134.2	96.7	39%
26.	Vidarbha	87.3	57.8	51%	0.0	13.0	-100%	0.3	5.4	-94%	87.6	76.2	15%
27.	Chhattisgarh	72.4	60.4	20%	0.0	9.8	-100%	1.8	5.3	-65%	74.3	75.5	-2%
28.	Coastal Andhra Pradesh & Yanam	200.7	182.2	10%	63.0	113.1	-44%	78.0	27.6	183%	341.7	322.9	6%
29.	Telangana	111.6	95.8	17%	1.0	23.0	-96%	6.4	5.3	21%	119.0	124.1	-4%
30.	Rayalaseema	141.2	132.1	7%	59.4	78.4	-24%	87.5	25.9	238%	288.1	236.4	22%
31.	Tamil Nadu, Pudcherry & Karaikal	166.0	172.0	-4%	178.6	181.9	-2%	101.1	89.4	13%	445.7	443.3	1%
32.	Coastal Karnataka	144.2	192.9	-25%	35.5	61.7	-43%	16.7	9.4	78%	196.4	264.0	-26%
33.	North Interior Karnataka	159.0	103.2	54%	2.5	23.4	-89%	7.2	4.9	46%	168.6	131.5	28%
34.	South Interior Karnataka	226.2	137.2	65%	30.9	51.2	-40%	43.0	10.6	306%	300.1	199.0	51%
35.	Kerala & Mahe	214.0	306.4	-30%	172.5	153.1	13%	89.6	32.4	177%	476.1	491.9	-3%
36.	Lakshadweep	120.7	153.0	-21%	68.7	120.3	-43%	113.2	61.6	84%	302.7	334.9	-10%

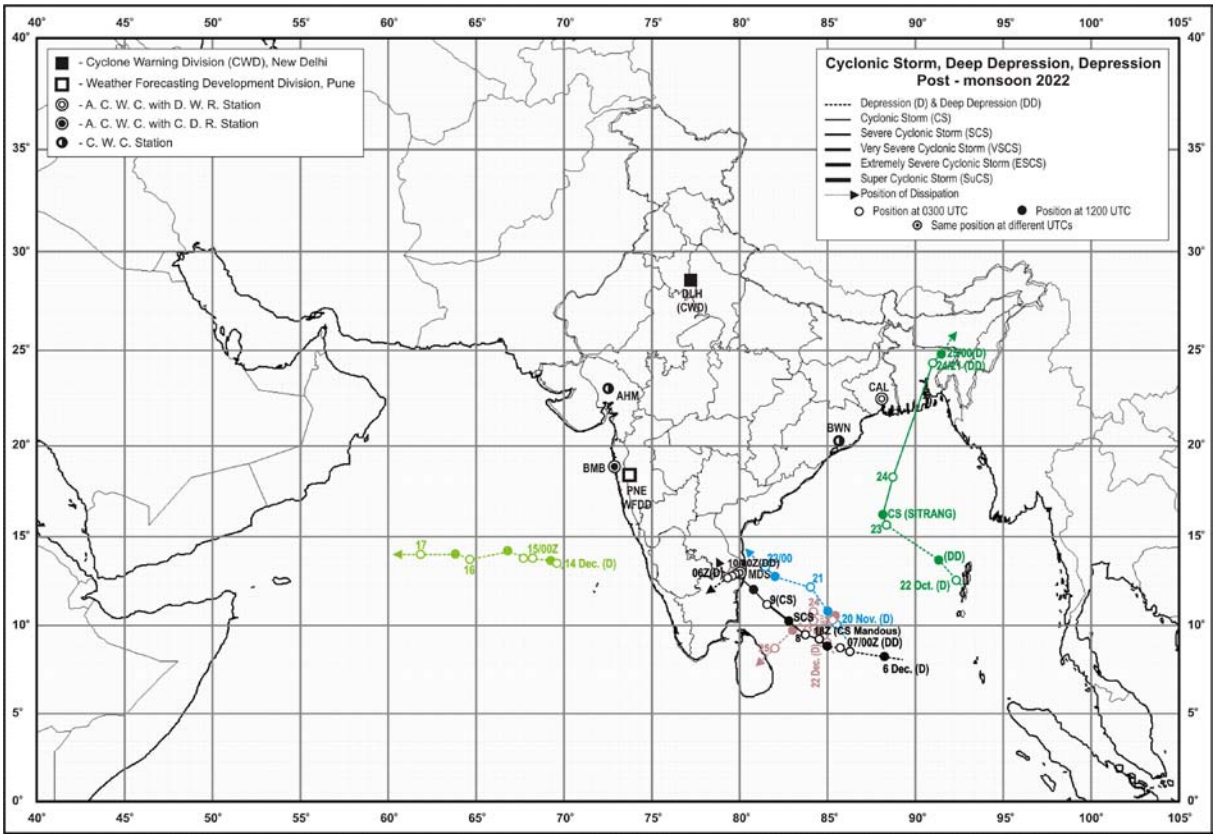


Fig. 2. Cyclones and depressions during post-monsoon season 2022

to shallow fog was observed over Madhya Maharashtra and Marathwada for 2 days each in the first fortnight of November.

La Nina conditions over the equatorial Pacific region, negative Indian Ocean Dipole (IOD) during the start of the season which became neutral during the latter half, Madden Julian Oscillation (MJO) either weak or in the western hemisphere barring a few days in December 2022 when it was in phase 3-4, were not favorable for northeast monsoon, especially in the first half of the season.

2. Seasonal rainfall (October–December)

The meteorological sub-division wise rainfall percentage departure from normal are given in Fig. 1 and Table 1. The precipitation in the post monsoon 2022 season was 119% of long period average (LPA), with the homogeneous regions of East & Northeast India and South Peninsula being *normal* while Northwest India and Central India precipitation being *excess*. Though the seasonal rainfall was *excess* or *normal*, it was highly skewed within the season. October being wetter than normal, for the country as well as all the four homogenous regions with northwest India recording 298% of L.P.A rainfall. November rainfall being highly deficient over the homogenous regions of East & Northeast and Central India. The monthly December precipitation was exceptionally high over the South Peninsula region while over all the other three regions it was remarkably low.

3. Monthly features

3.1. *October*

3.1.1. *Withdrawal of southwest monsoon*

In view of the establishment of an anti-cyclonic circulation in the lower tropospheric levels over western parts of Northwest India and substantial reduction in moisture content as well as rainfall, the southwest monsoon withdrew from parts of southwest Rajasthan and adjoining Kutch on 20th September against its normal date of 17th September. Further withdrawal was sluggish and the monsoon retreated from the entire country on 23rd October 2022.

TABLE 2

Details of the weather systems during October 2022

S. No.	System	Duration	Place of initial Location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Cyclonic storm*					
1.	Cyclonic Storm "SITRANG"	22 (0300 UTC) - 25 (0300 UTC)	Southeast and adjoining eastcentral Bay of Bengal	North	Northeast Bangladesh and neighborhood	Initially it lay as a cyclonic circulation over south Andaman Sea and neighbourhood on 17. It lay as a low pressure (LP) on 20, concentrated into a well marked low pressure (WMLP) on 21. The depression (D) weakened into WMLP on 0830 IST of 25, into a LP at 1430 hours IST on 25 and then became less marked at 1730 hours IST of 25, the associated cyclonic circulation became less marked on 26. Details are given in the article on Storms & Depressions over the north Indian Ocean-2022
(**B**)	*Well marked Low Pressure area/Low Pressure area*					
1.	Low pressure area	3-4	Westcentral Bay of Bengal and neighbourhood	West	West central Bay of Bengal off Andhra Pradesh coasts	Initially it lay as a cyclonic circulationover central parts of south Bay of Bengal off Andhra Pradesh coasts on 24September. L.P. became less marked on 5 October. Cyclonic circulation became less marked on 13 October over north Punjab and neighbourhood
(**C**)	*Western Disturbances/Eastward moving Systems*					
(*i*)	*As a trough*					
1.	At 3.1 km above m.s.l.	1-2	Roughly along Long. 68° E to the north of Lat. 30° N	East Northeast	-	It moved away east-northeastwards on 3
2.	At 5.8 km above m.s.l.	4-5	Roughly along 72° E to north of 28° N	Northeast	Roughly along 75° E to north of 32° N	Initially it lay as a as a cyclonic circulation over north Pakistan and adjoining Afghanistan at 3.1 km above m.s.l. It moved away northeastwards on 6
3.	At 5.8 km above m.s.l.	6-8	Roughly along 64° E to north of 24° N	Do	Roughly along 72° E to north of 32° N	It moved away east-northeastwards on 9
4.	At 5.8 km above m.s.l.	8-9	Roughly along 64° E to north of 32° N	Stationary	Roughly along 68° E to north of 25° N	It moved away east-northeastwards on 10
5.	At 5.8 km above m.s.l.	10-13	Roughly along 64° E to north of 25° N	Northeast	Roughly along 76° E to north of 30° N	It moved away east-northeastwards on 14
6.	At 5.8 km above m.s.l.	18-25	Roughly along 65° E to north of 32° N	East	Roughly along 90° E to north of 28° N	It lay as a cycir over northern parts of Jammu-Kashmir at 5.8 km above m.s.l. the western disturbance as a trough became less marked on 26
7.	At 5.8 km above m.s.l.	31 Oct - 4 Nov	Roughly along Long. 70° E to the north of Lat. 34° N	Do	Roughly along Long. 90° E to the north of Lat. 25° N	It moved away northeastwards on 5 November
(**D**)	*Other upper air cyclonic circulations*					
1.	Up to 5.8 km above m.s.l.	2	Northeast Bay of Bengal and neighbourhood	Stationary	*In situ*	Merged with the trough from cyclonic circulation associated with the low-pressure area over westcentral Bay of Bengal and neighbourhood to Bangladesh on 3

TABLE 2 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	Between 4.5 and 5.8 km above m.s.l.	5-10	Central parts of south Bay of Bengal	West	Southwest Bay of Bengal and adjoining north Sri Lanka coast	Became less marked on 11
3.	At 3.1 km above m.s.l.	7	Punjab and neighbourhood	Stationary	*In situ*	Became less marked same day evening
4.	Upto 1.5 km above m.s.l.	10-13	North Tamil Nadu and neighbourhood	South	Comorin area and neighbourhood	Became less marked on 14
5.	Upto 3.1 km above m.s.l.	11-15	North Andaman Sea and neighbourhood	West	Westcentral Bay of Bengal	Became less marked on 16
6.	Between 3.1 and 5.8 km above m.s.l.	13-19	Eastcentral Arabian Sea off Konkan -Goa coast	Southwest	Southwest Arabian Sea and neighbourhood	Became less marked on 20
7.	Up to 1.5 km above m.s.l.	16-19	Southeast Arabian Sea and adjoining Kerala coast	West	Eastcentral Arabian Sea off Maharashtra coast	Became less marked on 20
8.	Between 1.5 and 5.8 km above m.s.l.	20	Southeast Arabian Sea and adjoining Kerala coast	Stationary	*In situ*	Merged with the trough from the cyclonic circulation associated with the LP area over north Andaman sea and adjoining areas of south Andaman sea to southeast Arabian Sea on 21
9.	Upto 1.5 km above m.s.l.	20-21	Punjab and neighbourhood	Southeast	North Haryana and neighbourhood	Became less marked on 22
10.	Upto 1.5 km above m.s.l.	25-29	Westcentral Bay of Bengal and neighbourhood	South	Southwest Bay of Bengal and adjoining Sri Lanka	Merged with the cyclonic circulation over southwest Bay of Bengal off south Sri Lanka coast on 30
11.	Upto 1.5 km above m.s.l.	29 Oct - 6 Nov morning	Southeast Bay of Bengal and adjoining equatorial north Indian ocean	West	Southeast and adjoining southwest Arabian Sea	Became less marked on 6 November
(**E**)	*Other troughs/Wind Discontinuity*					
1.	Upto 1.5 km above m.s.l.	3-7	From the cyclonic circulation over westcentral and adjoining northwest Bay of Bengal to Bangladesh	Northeast	From the cyclonic circulation over southeast Rajasthan and neighbourhood to Punjab	Became less marked on 8
2.	Upto 0.9 km above m.s.l.	7	From coastal Andhra Pradesh to Gujarat	Stationary	*In situ*	Became less marked on 7 evening
3.	Upto 3.1 km above m.s.l.	9-10	From northeast Rajasthan to northeast Arabian Sea	East	From south Haryana to north Gujarat	Became less marked on 11
4.	At 1.5 km above m.s.l.	16-17	Southeast Arabian Sea and adjoining Kerala coast to southwest Bay of Bengal	Stationary	*In situ*	Became less marked on 18
5.	At 1.5 km above m.s.l.	18-19	From southeast Arabian Sea off Kerala coast to cyclonic circulation over eastcentral Arabian Sea off Maharashtra coast	Do	Do	Became less marked on 20

TABLE 2 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
6.	At 3.1 km above m.s.l.	18-22	From cyclonic circulation over north Andaman Sea and neighbourhood to Tamil Nadu coast	West	From the cyclonic circulation associated with the Deep Depression over westcentral and adjoining eastcentral Bay of Bengal to Comorin area across south Bay of Bengal and north Sri Lanka	Became less marked on 23 evening
7.	At 0.9 km above m.s.l.	31 Oct - 1 Nov	From the cyclonic circulation over southwest Bay of Bengal off north Sri Lanka coast to southeast Arabian Sea	Do	From the cyclonic circulation over north Sri Lanka and neighbourhood to southeast Arabian Sea	Became less marked on 2 November
(**F**) *Trough in easterlies*						
1.	Upto 1.5 km above m.s.l.	10-11	From Kerala to Marathwada across interior Karnataka	Oscillatory	From cyclonic circulation over Kerala and neighbourhood to southwest Madhya Pradesh	Became less marked on 12
2.	Upto 0.9 km above m.s.l.	26	From south interior Karnataka to southwest Bay of Bengal across Tamil Nadu	Stationary	*In situ*	Became less marked on 27

3.1.2. *Commencement of northeast monsoon rains*

In view of setting in of north easterly winds in the lower tropospheric levels over Bay of Bengal and South Peninsular India, the Northeast monsoon rains commenced over coastal areas of Tamil Nadu, Puducherry, Karaikal and adjoining areas of south Coastal Andhra Pradesh on 29th October and further covered Kerala, Mahe, south interior Karnataka, Rayalaseema and remaining parts of Tamil Nadu, Puducherry& Karaikal on 30th October 2022.

3.1.3. *Storms and depressions*

In October, under the influence of cyclonic circulation over north Andaman sea and neighbourhood, a low pressure area formed over north Andaman sea and adjoining areas of south Andaman sea and southeast Bay of Bengal on 20th October morning. It concentrated into a Depression at 0830 IST of 22nd over southeast and adjoining eastcentral Bay of Bengal, close to west of Andaman Islands near Lat. 12.7°N / Long. 92.4°E. it further intensified into a Deep Depression and lay centered at 0530 hours IST of 23rd near Lat. 15.4°N / Long. 89.0°E. Under favourable environmental conditions, it intensified into a Cyclonic Storm "Sitrang" and lay centered at 1730 hours IST of 23rd near Lat. 16.4°N / Long. 88.1°E. It crossed Bangladesh coast between Tinkona and Sandwip close to Barisal during 2100 hours IST and 2330 hours IST of 24th. It weakened into a Deep Depression over Bangladesh at 0230 hours IST of 25th, which further moved north-northeastwards, weakened into a well marked low pressure area and lay centered over northeast Bangladesh and adjoining Meghalaya at 0830 hours IST of 25th. It weakened into a low pressure area over south Assam and adjoining areas of northeast Bangladesh and east Meghalaya at 1430 hours IST of 25th which then became less marked on 26th. Owing to this storm, *scattered* to *fairly widespread* rainfall occurred with *isolated extremely heavy rainfall* over Meghalaya; *very heavy rainfall* over Arunachal Pradesh and *heavy rainfall* over Assam, Manipur during 24th -25th October and *isolated heavy rainfall* over Arunachal Pradesh on 25th -26th October.

3.1.4. *Other synoptic features and associated weather*

Table 2 provides a summary of the synoptic features for the month of October 2022. The sub-divisional percentage departures of rainfall from normal and significant amounts of rainfall are given in Tables 1 and 5, respectively.

TABLE 3

Details of the weather systems during November 2022

S. No.	System	Duration	Place of initial Location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**)	*Cyclonic storm*					
1.	Depression	20 (0000 UTC) - 22 (0300 UTC) morning	Southwest and adjoining southeast Bay of Bengal	Northwest	Westcentral and adjoining Southwest Bay of Bengal	Initially it lay as a cyclonic circulation over south Andaman seaand adjoining Southeast Bay of Bengal on 15 morning. Under its influence, a LP area formed on 17 and further to WMLP on 19. The D weakened into a WMLP area over westcentral and adjoining Southwest Bay of Bengal on 22 morning and into a LP on 22 evening. The LP area became less marked on 24 evening; however, the associated cyclonic circulation moved into the Arabian Sea and became unimportant on 28. Details are given in the article on Storms & Depressions over the north Indian Ocean-2022
(**B**)	*Well marked Low Pressure area/Low Pressure area*					
1.	Well marked Low Pressure	9-13	Southwest Bay of Bengal and adjoining equatorial Indian Ocean	West	Southeast Arabian Sea and adjoining areas of Lakshadweep islands	It formed under the influence of cyclonic circulationover southwest Bay of Bengal and adjoining equatorial Indian Ocean. The LP intensified to WMLP on 11.It weakened into a low-pressure area on 12 and became less marked on 14 morning, the associated cycir became less marked on 19
(**C**)	*Western Disturbances / Eastward moving Systems*					
(*i*)	*As a trough*					
1.	At 5.8 km above m.s.l.	4-5	Roughly along Long. 55° E to the north of Lat. 30° N	East	Roughly along Long. 60° E to the north of Lat. 30° N	Moved away northeastwards on 6
2.	Between 3.1 and 7.6 km above m.s.l	6-12	Roughly along Long. 55° E to the north of Lat. 30° N	Do	Roughly along Long. 88° E to the north of Lat. 28° N	Moved away east-northeastwards on 13 morning
3.	At 5.8 km above m.s.l.	13-14	Roughly along Long. 58° E to the north of Lat. 30° N	Do	Roughly along Long. 67° E to the north of Lat. 29° N	Moved away northeastwards on 15
4.	At 5.8 km above m.s.l.	15-17	Roughly along Long. 55° E to the north of Lat. 30° N	Northeast	Roughly along Long. 75° E to the north of Lat. 32° N	It moved away northeastward on 18
5.	At 3.1 km above m.s.l.	18-20	Roughly along Long. 55° E to the north of Lat. 32° N	Do	Roughly along Long. 74° E to the north of Lat. 32° N	It moved away northeastward on 21
(*ii*)	*As a cyclonic circulation*					
1.	At 3.1 km above m.s.l.	22-23	Jammu and neighbourhood	Southeast	Northwest Uttar Pradesh and neighbourhood	Became less marked on 24

TABLE 3 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
(*iii*) *Induced cyclonic circulations*						
1.	Upto 1.5 km a.s.l.	5-6	Central Pakistan and adjoining Punjab	East	Haryana and neighborhood	Became less marked on 7
2.	Upto 1.5 km a.s.l.	8-9	Southwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 10 morning
3.	Upto 1.5 km a.s.l.	14 morning	Central Pakistan and neighbourhood	Do	Do	Became less marked on 15
(**D**) *Other upper air cyclonic circulations*						
1.	Upto1.5 km above m.s.l.	3	Southwest Bay of Bengal and neighbourhood			It merged with the east-west trough running from cyclonic circulation over Kerala coast and neighbourhood to south Andaman sea on 4
2.	Between 3.1 and 4.5 km above m.s.l.	4-6	South Andaman Sea and adjoining southeast Bay of Bengal	West	Southeast Bay of Bengal and adjoining equatorial Indian Ocean	Merged with the east - west trough running from southeast Bay of Bengal and adjoining equatorial Indian Ocean to southwest Bay of Bengal on 7
3.	Up to 0.9 km above m.s.l.	7-8	Nagaland and neighbourhood	Do	Bangladesh and neighbourhood	Became less marked on 9
4.	Upto 0.9 km a.s.l.	16	Kerala and neighbourhood	Stationary	*In situ*	Became less marked on 17
5.	Upto 1.5 km above m.s.l.	20	Kerala and neighbourhood	Do	Do	Became less marked on 21
6.	Upto 3.1 km above m.s.l.	25-29	North and adjoining south Andaman Sea	Northwest	Central parts of Bay of Bengal	Became less marked on 30
(**E**) *Troughs*						
1.	Between 1.5 and 5.8 km above m.s.l.	2-3	From the cyclonic circulation over Tamil Nadu and neighbourhood to north Interior Karnataka	West	From the cyclonic circulation over south Tamil Nadu and neighbourhood to Lakshadweep area	Became less marked on 4
2.	Between 1.5 and 3.6 km above m.s.l.	4-9	From the cyclonic circulation over Kerala coast and neighbourhood to south Andaman Sea to southwest Bay of Bengal off Tamil Nadu coast	Oscillatory	From central Bay of Bengal to the cyclonic circulation associated with the low-pressure area over southwest Bay of Bengal and adjoining equatorial Indian Ocean	Became less marked on 10
3.	Between 1.5 km & 3.1 km above m.s.l.	13-14	From the cyclonic circulation associated with low pressure area over southeast Arabian Sea off Kerala coast to southwest Bay of Bengal on 13	Do	From the cyclonic circulation over southeast Arabian Sea to Comorin area across Kerala and south Tamil Nadu	Became less marked on 15

TABLE 4

Details of the weather systems during December 2022

S. No.	System	Duration	Place of initial Location	Direction of movement	Place of final location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(**A**) *Cyclonic Storm*						
1.	Severe Cyclonic Storm "Mandous"	6 (1200 UTC) - 10 (1200 UTC)	Southeast Bay of Bengal near Lat. 8.2° N / Long. 88.2° E	West Northwest	North Tamil Nadu near Lat. 12.7° N / Long. 79.3° E	Initially it lay as a cyclonic circulation over south Andaman Sea and adjoining equatorial Indian ocean - Strait of Malacca which extended upto 5.8 km above m.s.l. on 4 morning. Under its influence, a LP area formed over south Andaman sea and neighbourhood on 5 morning. It intensified into a WMLP over southeast Bay of Bengal on 6 morning. The D weakened into WMLP on 10 and further into LP which became less marked on 11 morning. The associated cycir lay over north Kerala and neighbourhood on 12. Details are given in the article on Storms & Depressions over the north Indian Ocean-2022
2.	Deep Depression	14 (0900 UTC) - 17 (1200 UTC)	Eastcentral and adjoining southeast Arabian Sea near Lat. 13.5° N / Long. 69.6° E	West southwest	Westcentral Arabian Sea near Lat. 14.0° N / Long. 61.9° E	Under the influence of the remnant cycir of the above system a LP area formed over southeast and adjoining eastcentral Arabian Sea off north Kerala-Karnataka coasts with the associated cyclonic circulation extending upto 7.6 km above m. s. l. on 13. It concentrated into a WMLP on 13 evening. The D weakened into WMLP on 17 evening and to LP on 19, which became less marked on 20 morning. Details are given in the article on Storms & Depressions over the north Indian Ocean-2022
3.	Depression	22 (0300 UTC) - 25 (0900 UTC)	Southwest and adjoining southeast Bay of Bengal near Lat. 9.0° N / Long. 85.0°E	West	Sri Lanka	Under the influence of the cyclonic circulation over south Andaman sea, adjoining strait of Malacca and Sumatra, a LP area formed over equatorial Indian ocean and adjoining areas of south Andaman sea and southeast Bay of Bengal at 1430 hours IST of 14. It lay as a WMLP over southwest Bay of Bengal and adjoining east equatorial Indian ocean on 21 morning. The D weakened to WMLP on 26 morning over Comorin area and adjoining Sri Lanka coast and to a LP over the same region in the forenoon of 26,which became less marked on 27. The associated cyclonic circulation became less marked on 30. Details are given in the article on Storms & Depressions over the north Indian Ocean-2022
(**C**) *Western Disturbances / Eastward moving systems* (*i*) *As a Trough / Trough in westerlies*						
1.	At 5.8 km above m.s.l.	2-5	Roughly along Long. 56° E to the north of Lat. 25° N	Northeast	Roughly along Long. 72° E to the north of Lat. 32° N	Moved away eastwards on 6

TABLE 4 (*Contd*.)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 5.8 km above m.s.l.	6-10	Roughly along Long. 58° E to the north of Lat. 33° N	East	Roughly along Long. 70° E to the north of Lat. 32° N	It lay as a cyclonic circulation over north Pakistan and adjoining Punjab at 3.1 km above m.s.l. on 11 which moved away northeastward on 12
3.	At 7.6 km above m.s.l.	11-14	Roughly along Long. 56° E to the north of Lat. 26° N	East northeast	Roughly along Long. 68° E to the north of Lat. 32° N	It lay as a cyclonic circulation over east Afghanistan and neighbourhood at 5.8 km above m.s.l. on 13. Moved away northeastwards on 15
4.	At 3.1 km above m.s.l.	17-18	Roughly along Long. 91° E to the north of Lat. 23° N	Northeast	Roughly along Long. 92° E to the north of Lat. 23° N	Moved away northeastwards on 19
5.	At 3.1 km above m.s.l.	19-21	Roughly along Long. 85° E to the north of Lat. 24° N	Northeast	Roughly along Long. 90° E to the north of Lat. 25° N	Moved away northeastwards on 22
6.	At 5.8 km above m.s.l.	17-21	Roughly along Long. 53° E to the north of Lat. 25° N	Northeast	Roughly along Long. 70° E to the north of Lat. 30° N	Moved away northeastwards on 22
7.	At 3.1 km above m.s.l.	22	Roughly along Long. 63° E to the north of Lat. 26° N	East	Roughly along Long. 72° E to the north of Lat. 26° N	It lay as a cyclonic circulation in lower and middle tropospheric westerlies over Afghanistan and neighbourhood on 23. It lay as a trough in middle tropospheric westerlies with its axis at 5.8 km above m.s.l. on 24, which moved away east-northeastward on 25
8.	At 5.8 km above m.s.l.	25-27	Roughly along Long. 50° E to the north of Lat. 32° N	East	Roughly along Long. 58° E to the north of Lat. 32° N	Moved away northeastwards on 28
9.	At 5.8 km above m.s.l.	28-29	Roughly along Long. 53° E to the north of Lat. 26° N		Roughly along Long. 58° E to the north of Lat. 30° N	It lay as a cyclonic circulation over north Pakistan and neighbourhood at 3.1 km above m.s.l. with a trough aloft in mid tropospheric westerlies with its axis at 5.8 km above m.s.l. ran roughly along Long. 70° E to the north of Lat. 30° N on 30th which became less marked on 31st December morning. However, the trough aloft in lower and mid tropospheric westerlies moved away northeastwards on 2 January, 2023
(*ii*) As an induced cyclonic circulation						
1.	Upto 1.5 km a.s.l.	29-30	North Pakistan and neighbourhood	East	Punjab and neighbourhood	Became less marked on 31 morning
D) *Trough in Easterlies*						
1.	At 0.9 km above m.s.l.	4	From Comorin area to north Kerala coast at 0.9 km above m.s.l.	Stationary	*In situ*	Became less marked on 5
(**E**) *Other Troughs*						
1.	At 1.5 km a.s.l.	28	Roughly along Longitude 86°E to the north of Latitude 23°N	Stationary	*In situ*	Became less marked on 29

TABLE 5

Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)

Date	Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)
1 Oct	Addanki 18, Masulipatnam Cdr and Gaganbawada 11 each, Shirahatti 10, Chhamonu and Vangoor 9 each, Karamchedu, Markapur and Sabroom 8 each, Macherla 7
2 Oct	Vaibhavwadi 12, Amarapuram 11, Harinkhola 10, Ongole, Rameshwar ARG and B Durga 9 each, Avanigada and Addanki 8 each, Dharmanagar/Panisagar, Devgad, Kankavli, Bagati and Sabroom 7 each
3 Oct	Palakkad 11, PeermadeTo and Kuppady 9 each, Umiam ARG, Gokulpur AWS, Udaipur and Agartala AP 8 each, Khliehriat, Cherrapunji, Bhaghmara, Bishalgarh, Barkisuriya, Arkalgud, Jamsolaghat and Palayankottai 7 each
4 Oct	Kakatpur 16, Astaranga and Balikuda 14 each, Naugaon 13, Rajnagar 12, Gop 11, Basudevpur 10, Aul 9, Alipingal and Chandbali 8 each, Koner, Jaleswar, Bhograi, Ekangersarai, Marsaghai, Rajkanika, Kadwa, Bhawnathpur, Digha, Raiganj PTO and Dhurki 7 each
5 Oct	Sahebpur Kanal 14, Palasa, Bhalukpong, Tihidi, Kvk Dhalai and Gosani 13 each, Berhampur, Sabour, Cheria B. pur1, Bahri, Bhadrak, Lavkushnagar, Khagadia, Odagi, Majbat, Sankheimundi and Bahraich 11 each, Bhinga, Raiganj PTO, Paralakhemundi, Gopalpur, Kursela and Chhatrapur 10 each, Kantapada, Polsara, Barkote, Bahanga, Digapahandi, Tarapur, Nimpara, Udai Kishanganj, Naktideul, Remuna, Dharhara, Tekkali and Gandecherra 9 each, Patrapur, Banki, Suryagadha, Kalinga, Ramnagar, Gonour, Pawai, Derabis, Garadapur, Jorhat, Nauhatta, Gharmura, Kodawanpur/C.bIi, Bakulia, Bhagalpur and Purushottampur 8 each, Bahadurganj, Jorhat AWS, Sheragada, Balikuda, Bari, Kukudahandi, Astaranga, Gop, Khajuripada, Rajmahal, Chauldhowaghat, Chandbali, Monghyr, Poonjar AWS, Rupouli, Balasore, Barauni, Khaira, Amanganj, Ganjam, Dhamnagar, Subramanya, Nischintakoili, Sompeta, Borio, Dharakote and Kakatpur 7 each
6 Oct	Trimohani Ghat Fmo 41, Gonda CWC and Gonda Sadar 36 each, Ayoadhya and Bansi Tehsil 31 each, Chanderdeepghat 30, Bhinga 23, Uska Bazar Fmo 22, Kakerdarighat 21, Elgin Bridge 20, Gorakhpur and Haraiya 18 each, Mau Tehsil 17, Fatehpur Tehsil, Patti, Kaiserganj and Falakata 16 each, Maharajganj, Nichlaul, Raniganj, Tanda and Tribeni/Balmikinagar 15 each, Haidargarh, Lambhuaa, Sultanpur, Ramnagar, Ayodhya(ag) and Notanwa 14 each, Pharenda, Kunda, Birdghat, Karwi and Bhalukpong 13 each, Repalle, Lalganj Aara, Lucknow(Cr), Basti, Basti(t) and Basti CWC 12 each, Bahraich, Tarabganj, Balrampur(t), Pratapgarh(t) and Konakanamitla 11 each, Shoharatgarh, Chauldhowaghat, Palakkad, Cumbum, Bestavaripeta, Lucknow(hs), Kodangal, Wargal, Bhanpur, Gopalpet and Colonalganj 10 each, Malihabad, Ikauna, Mankapur, Gaurihar, Khila Ghanpur, Fursatganj, Marripudi, Bagrakote, Srungavarapukota and Tulasipur 9 each, Subramanya, Visakhapatnam, Kottur, Rajnagar, Mani, Venkatapuram, Podili, N.lak/Lilabari, Bara Banki, Banda CWC, Sultanpur CWC, Bansi CWC, Bansgaon, Regoli, Akbarpur and Nawabganj Tehsil 8 each, Lavkushnagar, Wanaparthy, Sohagpur, Balrampur, Piduguralla, Bikapur, Ajaigarh, Itanagar, Perinthalamanna, Gaunaha, Pottangi, Kaptipada, Jaisinagar, Kammar Palle, Ram Sanehi Ghat Tehsil, Kanpur Teh, Avanigada, Roshnabad, Soraon, Dalmau CWC, Ongole, Angadipuram, Narsapuram, Saroornagar, Bathalapalle, Raptadu, Jammalamadugu, Deoria, Sirauli Gauspur Tehsil, Amaravati and Kancheepuram 7 each
7 Oct	Kakerdarighat and Tribeni/Balmikinagar 15 each, Nagda, Duvvur and Susner 14 each, Khandwa, Gulana, Gaganbawada and Ramnagar 13 each, Paranda, Ratnagiri, Nalkheda, Jambughoda, Palliakalan and Haidargarh 12 each, Baheri, Ichhawar and Kheri Lakhimpur 11 each, Mani, Bhinga and Nevasa 10 each, Moman Badodiya, Raju Palem, Ankola, Nellimarla, Naraj, Sailana and Ratlam-aws 9 each, Biaora, Peddemul, Bhokar, Zirapur, Konaraopeta, Rajnagar, Jawar, Kolar, Mundali, Atchampet, Morva Hadaf, Uska Bazar Fmo, Elgin Bridge, Nanpara and Bahraich 8 each, Khachrod, Mahidpur, Devendranagar, Banpur, Bhapur, Raisen-aws, Pirawa, Khaknar, Pulivendla, Mahsi, Balrampur, Godhra, Tiruvuru, Palasa, Yelamanchili, Mentada, Bhimadole, Vempalle, Chicholi, Kankavli, Karjat, Pachora, Karad, Puzhal ARG, Belikeri, Kalwakurthy, Thimmajipeta, Atmakur Wnp and Kinwat 7 each
8 Oct	Dhaurahara 24, Kolaras and Murud 16 each, Narwar 15, Etawah (CWC), Pichhore, Panvel ARG and Azamgarh 14 each, Shivpuri, Pohri, Karauli and Sardanagar 12 each, Santacruz, Ambernath, Thane, Bhinga, Mhasla, Matheran, Zirapur, Mangaon, Khaniyadana, Shriwardhan and Subir 11 each, Roan, Roha, Uran, Anakapalle AP and Lalbegiaghat 10 each, Palghar ARG, Colaba, Kalyan, Ulhasnagar, Tala, Mandalgarh, Etawah, Mihona and Badoda 9 each, Ghatigaon, Jawad, Dhar-aws, Aliganj, Kheri Lakhimpur and Vijaypur(adp) 8 each, Kessariah, Veerpur, Ater, Gogawan, Gautampura, Bhiwandi, Bhitarwar, Murbad, Kumbhraj, Sajjangarh SR, Khalapur, Bhalukpong, Baran, Chabra, Kishanganj, Mangrol, Dholpur Tehsil SR, Aklera, Pachpahar SR, Mandrayal SR, Pipalda SR, Chhotisadri, Chothkabarwara SR, Alangayam, Bakulia, Sallopat SR, N.lakhimpur/Lilabari, Chanderdeepghat, Nighasan, Khairagar, Kalpi Tehsil, Kalpi CWC, Sambhal, Devgadh Baria, Umerpada, Vadia, Bhavnagar, Polavaram and Datia 7 each
9 Oct	Kotkasim SR 21, Dausa and Chandausi 19 each, Bharatpur Tehsil SR 18, Kishngarhwas SR 17, Baheri, Sikrai, Aligarh and Baswa 16 each, Dhaurahara, Nagina REV, Govindgarh SR and Viratnagar SR 15 each, Nagar SR, Narora and Kathumer 14 each, Etah, Ramgarh SR, Shahpura SR, Kukatpally Jntu(ARG), Beir SR, Bamanwas SR, Nadbai and Palwal 13 each, Sadabad, Nadoti, Sahaswan, Khandar SR, Majitar, Rupbas, Taoru, Nuh, Mandkhola AWS and Sohana 12 each, Dhubri CWC, Faridabad, Milak, Sps Mayur Vihar, Bareilly CWC, Porsa, Sabalgarh, Kasganj, Morena-aws, Moradabad CWC, Nainital, Parbatsar, Nimarana, Malakhera SR, Sarmathura SR, Pahari SR, Bayana and Behror 11 each, Mukteshwar, Jhirka, Kaman, Sambhal, Gangapur, Budaun, Mozamabad SR, Rongo, Bahadurpur SR, Mandawar, Alwar Obs, Gurgaon AWS, Chauldhowaghat, Mehgaon, Bareilly PBO, Hindaun, Tizara SR, Ballabgarh and Malerainadunger SR 10 each, Moradabad, Lodi Road, Lalsot, Vrindavan, Pakyong, Lohaghat, Kumher SR, Pithoragarh, Mahwa, Mangan, Thanagazi, Pantnagar, Todabhim, Punhana, Nawabganj, Palliakalan, Ranjit Sagar Dam Site, Auraiya (CWC), Badatighat, Paowta, Bassi, Pusa AWS, Agra (CWC), Budalur, Anupshahr, Sholingur, Aya Nagar, Jalesar, Hathras and Hodal 9 each, Neemuch-aws, Vijaypur(adp), Williamnagar, Rajgarh, Dhar-aws, Gormi, Sapotra, Gohad, Atrauli, Gurgaon REV, Alwar SR, Haldwani, Betalghat, Banbasa, Mawana, Almora, Pawayan, Aonla, Sasani, Chomu, Bilaspur, Hathin and Bilari 8 each, Berhampur, Tadang, Bulandshahr, Lachmangarh, Manethi REV, Bansur, Karjan, Sports Complex AWS, Sikandarabad, Niwai, R.s.mangalam, Rameswaram, Sivakasi, Naharlagun, Tikrikilla, Mandrayal SR, Muhammadi, Agra, Aliganj, Safdarjung, Jasrana, Baseri SR, Mant, Kanth, Puranpur, Champawat, Kashipur, Kalingapatnam, Alipur (jaura), Tapukara and Sawai Madhopur 7 each

TABLE 5 (*Contd*.)

Date	Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)
10 Oct	Kumargram 31, Mirganj 23, Pasighat AP 21, Nawabganj, Forbesganj and Mangan 18 each, Najibabad and Nagina 17 each, Bijnor 16, Sardanagar 15, Sankalan 14, Nainital, Ramnagar, Neemsar, Kunda and Itanagar 13 each, Naharlagun, Kalpi CWC, Manjalaru, Sivaganga, Kalpi Tehsil and Akbarpur Knp Dht 12 each, Ranganadi Nt Xing, Kaiserganj, Hamirpur CWC, Tirwa, Shahjina Fmo, Fatehpur Tehsil, Hamirpur, Paramathivelur, Alipurduar PTO and Jukkal 11 each, Nighasan, Patti, Phangota, Gobichettipalayam, Hasanganj, Mawana, Narora and Dhampur 10 each, Buxaduar, Gunnaur, Bareilly PBO, Faridpur, Kuppam, Motihari, Mukteshwar, Haldwani, Sambhal, Orai, Lalganj Aara, Bareilly CWC, Malihabad, Puduchatram, Jonai ARG, Roing, Namakkal and Kheri Lakhimpur 9 each, Kanth, Sikandra Rao, Falakata, Naina Davi, Barobhisha, Moradabad, Bevoor, Kashipur, Sendamangalam, Takha, Kuppady, Almora, Amfu Pundibari, Lohaghat, T Narasipur, Moradabad CWC, Silapathar ARG, Tallakulam, Hardoi Teh, Kamatchipuram, Bhatpurwaghat, Vedasandur, Hardoi, Ranjit Sagar Dam Site, Purwa, Atrauli, Budaun, Shipgyar, Kodumudi, Dindigul, Bindki, Sirauli Gauspur Tehsil, Nawabganj Tehsil, Madurai South, N.lakhimpur/Lilabari and Degloor – Fmo 8 each, Galgalia, Uthiramerur, Chepan, Sabalgarh, Kaveripakkam, Hunsur, Srirangapatna, Rasipuram, Omalur, Banbasa,Vizianagaram, Dhemaji, Pratapgarh (t), Kannauj (t), Misrikh, Chhibramau, Sahaswan, Aonla, Ram Sanehi Ghat Tehsil, Chauldhowaghat, Gossaigaon, Etawah, Rath, Hathras, Yingkiong, Mentada, Bhogaon, Tuting, Jansath, Lucknow(Ap), Betalghat, Tiruvallur, Chembarabakkam, Chembarambakkam ARG, Pithoragarh, Khatima, Pantnagar, Palasa and Bayana 7 each
11 Oct	Pasighat AP 22, Gossaigaon 19, Gossaigaon AWS 18, Mettupatti, Alipurduar PTO and Kokrajhar 17 each, Barobhisha, Bahalpur, Mawsynram and Roing 14 each, Bichhia 13, Panchapatti, Chepan and Tura AWS 12 each, Ramnagar, Tonkhurd, Deori, Cherrapunji, Shella, Bankhedi, Nawanshahr, Patan and Tura Kvk 11 each, Mangan, Nepanagar, Pavagada, Chauldhowaghat, Williamnagar and Udaipura 10 each, Singhik, Agali, Davanagere PTO, Pulipatti, Rampur, Thammampatty, Jamner, Sendhwa (med), Mahua, Tendukheda, Kaiserganj, Sankalan and Shahpura 9 each, Karanjia, Beohari, Kareli, Rewa-aws, Tavaragera, Rajgarh, Chungthang, Haidargarh, Tuting, Tirupathur PTO, Cherrapunji (rkm), Samana ARG, Radaur, Gohar, Mawkyrwat ARG, Nawabganj, Chakrata, Bagrakote, Dharmsala and Guler 8 each, Sagar-aws, Nh31 Bridge, Phillaur, Semariya, Gonour, Chandia, Mohgaon, Nowrozabad, Sidhi(gopadbanas), Gobichettipalayam, Singodi, Peddapuram, Vadipatti, Bijni ARG, Jonai ARG, Goalpara AWS, Goalpara CWC, Majuli, Ampati, Mawkyrwat, Nongstein, Bareilly CWC, Orai, Markachou, Madakasira, Majholi, Igatpuri, Nashik, Dharmshala AWS, Badami, YN Hoskote, Bairagarh Airport, Bhopal Arera Hills, Ashta-aws, Amarkantak, Paraswada, Bajag, Jabalpur-aws and Ksndmc Campus 7 each
12 Oct	Nalhati and Bhandara 14 each, Sankalan and Debagram 13 each, Karimganj and Sri Niketan 12 each, Kawadimatti ARG, Tura AWS and Salar 11 each, Mangan, Kirnapur, Chinnakalar, Pasighat AP, Dumka, Pachhad and Bagrakote 10 each, Malanjkhand, Majholi, Gheropara, Rongo, Neora, Singhik, Gaganbawada, Birpur, Jhorigam, Jamshedpur, Mahur, Baihar, Mohadi and Tirora 9 each, Rampurhat (DRMS), Goalpara CWC, Kaiserganj, Messenjor, Roing, Buxaduar, Kandi, Seethathode AWS, Mauda and Tumsar 8 each, Dadupur, Jalahalli, Tura, Purnea, Thenparanadu, Chargharia, Gogri, Kumarapalayam, Silchar AWS, Akole, Ranganadi Nt Xing, Manteswar, Chauldhowaghat, Rajnagar, Perseoni, Karwi, Gobindpur, Chungthang, Godda, Godda Kvk AWS, Amgaon, Paraswada, Goregaon, Pennagaram, Haveri Apmc and Shirali 7 each
13 Oct	Devanakonda 16, Rayadurg 14, Raibagh and Dhubri IMD 13 each, Dhubri CWC, Jammalamadugu, Amfu Majhian and Kerur 12 each, Banaganapalle, Vadipatti and Nandavaram 11 each, Ramanujnagar, Gooty, Pagidyala and Gonegandla 10 each, Rajapalayam, Kurdi, Madhugiri, Bilgi(irri.), Kusmi, Puttur and Altuma 9 each, Vangoor, Ghasipura, Chegunta, Similiguda, Midigeshi, Uluberia, Boudhgarh, Madhugiri ARG, Kantapada, Phiringia, Ghatagaon, Balrampur, Alur, Srivilliputhur, Yemmiganur, Nandyal, Jupadu Bungalow, Hindupur and Tikrikilla 8 each, Bagalkote PTO, Kamakhyanagar, Gorantla, Jamshedpur, Cherrapunji, Biridi, Korei, Pilavakkal, Satankulam, Barmul, Chandbali, Raikode, Thambalapalle, Gopalpet, Naina Davi, C Belagal, Mahbubnagar, Medchal, Hakimpet IAF, Jukkal, Hyderabad AP, Channagiri, Manvi, Pulivendla, Kankavli and Kondapur 7 each
14 Oct	Ashti 12, Hebburu and Saligrama 11 each, Thondebhavi, Khowang, Itc Jala and Myladumpara ARG 10 each, Muddanur, West Kallada AWS, Neyyattinkara, Kunigal and Kalasa 9 each, Hesaraghatta, Hut Bay, Balehonnur, Bhavani, Pulivendla, Pechiparai, Anchal ARG, Hindupur, Addanki, Chamarajanagar, Konni ARG, Gubbiand Gudivada 8 each, Belur, Gowribidanur, Pennagaram, Ksndmc Campus, Bengaluru City, Mahagoan, Washi, Bhum, Nallamada, Thenmala ARG, Rameswaram, Kumarapalayam, Chittar and Purulia 7 each
15 Oct	Mandya 17, Amalapuram 15, Tirupuvanam 12, Tirumayam, Visakhapatnam, Tirupathur and Valpoi 11 each, Denkanikottai and Polavaram 10 each, Kakinada, Kollegal, Pathri, Mulug, Venkatapur, Yanam, Kondapak, Vepur, Guntur, T Narasipur, Peermade To, Sivaganga, Kovilankulam, Natham and Bhavani 9 each, Malur, Manthala, Govindaraopet, Ashti, Madurai South, Pune, Yedrami, Harur, Kanakapura and Virudunagar AWS 8 each, Pandavapura, Gambhiraopet, Bejjanki, Dharmasagar, Karimnagar, Ahmednagar, Atmakurwrgl, Sadasivanagar, Parbhani, Siddipet (ARG), Paud Mulshi, Banswada, Visakhapatnam AP, Tallakulam, Viraganur Dam, Labbaikudikadu, Hosur, Chengam, Avanigada, Yelamanchili, Hagaribommanahalli, Vepada, Narsapuram, Kurinjipadi, Sangamner, Gangakhed, Purna and Sholayar 7 each
16 Oct	Lower Kothaiyar ARG 13, Yanam, Vedaranniyam, Ramanagara, Saligrama and Hunsur 9 each, Bhagamandala, Ottapalam and Kanakapura 8 each, HDKote, Wadenapally (ARG), Krishnarajpet, Hogenekal, Kakinada, Peringalkuthu AWS, Varkala, Anchal ARG, Cherthala, Karaikudi, Vadipatti, Pechiparai and Hassan 7 each
17 Oct	Kankavli and Namakkal 11 each, Neryamangalam ARG 10, Periakulum, Palacode, Mylaudy, Osmanabad and Mohanur 9 each, Vedaranniyam, Mulde ARG, Hosapete, Uravakonda, Chinnakalar and Kodumudi 8 each, Srimushnam, Kanjirapuzha ARG, Perumkadavila ARG, Yercaud, Veeraganoor, Dodamarg, Rasipuram, Paramathivelur, Lower Kothaiyar ARG and Andipatti 7 each
18 Oct	Poonjar AWS 14, Aranmanaipudur, Purandar Sasvad and Periyakulam 13 each, Peermade To and Sinnar 12 each, Neyyattinkara, Pune and Trivandrum AP 11 each, Thuckalay, Shevgaon, Thodupuzha and Sholayar 10 each, Neryamangalam ARG, Karipur Ap., Thiruvananthapuram, Sattur, Vellayani AWS, Vadipatti, Lower Kothaiyar ARG, Padegaon ARG, Bhimpur and Valparai PTO 9 each, Peringalkuthu AWS, Chinnakalar, Myladumpara ARG, Usilampatti, Perunchani Dam, Eraniel, Colachel and Chauri 8 each, Varkala, Idukki, Vaigai Dam, Chalisgaon, Pechiparai and Valparai Taluk Office 7 each

TABLE 5 (*Contd*.)

Date	Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)
19 Oct	Trimbakshwar and Devarhippargi 12 each, Colachel and Peravurani 9 each, Vyttiri and Maddur 8 each, Katpadi, Hesaraghatta, Madhugiri ARG and Madhugiri 7 each
20 Oct	Rahata 15, Dharmasagar, Denkanikottai and Rameswaram 10 each, Trp Town 9, Raghunathpalle, Mysuru PTO, Bengaluru HALAP, Irikkur and Manantoddy 8 each, Thanjavur, Natham, Kopargaon, Salem, Savlivihir ARG, Yeola, Kadaladi, Jnanabharathi Bu Campus,Empri, Maddur, Hosur, Kodumudi and Valparai PTO 7 each
21 Oct	Junnar 11, Kanjirapuzha ARG 10, Tirumayam, Tondi and Parli Vaijnath 9 each, Vadipatti, Avudayarkoil, Tirupuvanamand Latur 8 each, Kallamb, Lohara and Haliyal 7 each
22 Oct	Roha 10, Anakayam ARG, Car Nicobar and Bombay Santacruz 9 each, Thodupuzha 8, Akole and Sangli 7 each
23 Oct	Kurudamannil 9
24 Oct	Kayamkulam ARG 14, Bishalgarh 9, Thenkasi, Neryamangalam ARG and Peruvannamuzhi ARG 7 each
25 Oct	Mawsynram and Mawphlang 25 each, Williamnagar 23, Sohra (cher) 22, Shillong AWS 21, Shillong CSO 20, Mawkyrwat, Mawkyrwat ARG and Barapani 18 each, Umiam ARG 16, Jowai and Williamnagar AWS 14 each, Bomdila and Khliehriat 12 each, Bhaghmara, Khanapara, Nongstein, Ukhrul and Kalaktang 10 each, Khetri ARG, Shella, Kibithu and Ukhrul AWS 9 each, Zero, Drf, JB Gaon, Basar, Umrangso, Nongpuh and Goibargaon 8 each, Senapati, Udalguri AWS, Majbat, Suralacode, Nalbari/Pagladia, Melabazar/Matunga, Umrangshu ARG, Kheronighat, Koloriang, Guwahati City IMD, Chandrapur ARG, Goalpara CWC, Mangaldai AWS, Tamulpur, Kabu Basti, Jung ARG, Tawang and Guwahati ARG 7 each
26 Oct	Koloriang 10, Bhalukpong and Kohima 8 each, Miao and Tuting 7 each
27 Oct	Thoothukudi Har 8, Thoothukudi Port AWS 7
28 Oct	Nil
29 Oct	Cuddalore 8, Puducherry AP 7
30 Oct	Nil
31 Oct	Ernakulam South and Quilandi 7 each
1 Nov	Red Hills 13, Perambur 12, Alapuzha and Chennai Collectorate Bu 11 each, Mandapam, Cd Hospital Tondaipet, Kollam Rly, Ponneriand Gummidipoondi 10 each, Neyyattinkara, Perumkadavila ARG and Ayanavaram Taluk Office 9 each, Nellore, Kottayam, Chennai(n), Cholavaram and Thuckalay 8 each, Karaikal, Thodupuzha, Palluruthy ARG, Mgr Nagar and Dgp Office 7 each
2 Nov	Avadi, Chennai Collectorate Bu and Perambur 17 each, Ponneri and Kvk Kattukuppam ARG 16 each, Red Hills and Gummidipoondi 14 each, Ayanavaram Taluk Office, Ambathur, Cheyyur, Nungambakkam, Sholinganallur and Mgr Nagar 13 each, Anna University 12, Srivilliputhur, Thirupporur, Dgp Office, Tada and Sullurpeta 11 each, Chennai AP 10, Cd Hospital Tondaipet, Satyavedu, Sriperumbudur, Thamaraipakkam and Chembarabakkam 9 each, Koratur, Cholavaram and Velankanni 8 each, Walajabad, Vandavasi, Cheyyar, Tiruvallur, Tirupati AP, Kanakapura, Mahabalipuram and Ettayapuram 7 each
3 Nov	Sirkali 22, Thanjavur 18, Kollidam 16, Chidambaram 15, Chidambaram AWS and Sethiathope 13 each, Annamalai Nagar, Thanjavur PTO and Parangipettai 12 each, K.m.koil, Lalpet, Bhuvanagiri and R.s.mangalam 11 each, Neryamangalam ARG and Illayangudi 10 each, Tarangambadi, Usilampatti, Mahabalipuram and Manamadurai 9 each, Alwaye PWD, Kamudhi and Manalmedu 8 each, Vadipatti, Tirupuvanam, Mylaudy, Thirukalukundram, Maduranthagam, Peruvannamuzhi ARG, Neivasal Thenpathi and Kamudhi ARG 7 each
4 Nov	Cd Hospital Tondaipet 14, Mettupalayam and Dgp Office 12 each, Peermade To 11, Kayalpattinam and Vedaranniyam 10 each, Perambur 9, Kadambur, Kayathar ARG, Srivaikuntam, Chennai Collectorate Bu and Kayathar 8 each, Ambathur, Red Hills, Anna University, Chennai(n), Ayanavaram Taluk Office and Collectorate 7 each
5 Nov	Kottayam 13, Vaikom 11, Kodiayakarai 9, Rameswaram 8, Cherthala, Kozha, Kottaram and Kulasekarapattinam 7 each
6 Nov	Eraniel 8
7 Nov	Kottarakkara AWS 11, Anakayam ARG 9, Kanjirappally 8
8 Nov	Nil
9 Nov	Kottarakkara AWS 7
10 Nov	Nil
11 Nov	Kollidam 11, Parangipettai 10, Chidambaram AWS 9, Cuddalore, Velankanni and Sirkali 8 each, Mahabalipuram, Ponneri, Collectorate, Annamalai Nagar, Taramani ARG, Mayiladuthurai, Puducherry, Tirupoondi, Thalaignayer, Chennai(n), Karaikal, Kvk Kattukuppam ARG and Vedaranniyam 7 each

TABLE 5 (*Contd*.)

Date	Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)
12 Nov	Sirkali 44, Kollidam 32, Chidambaram 31, Annamalai Nagar 28, Chidambaram AWS 27, Bhuvanagiri 21, K.m.koil and Kothavacherry 19 each, Tarangambadi and Parangipettai 18 each, Manalmedu, Mayiladuthurai, Sethiathope and Kurinjipadi 16 each, Kangeyam 15, Ponnamaravathi, Lalpet and Vellakoil 13 each, Aravakurichi, Mylampatti and Vadakuthu 12 each, Karaikal, Tiruppur, Vanamadevi, Src Kudithangi, Karaiyur, Vedasandur, Ulundurpet and Vepur 11 each, Agaram Seegoor, Paramathivelur, Collectorate, Cheyyur, Virudachalam, Rscl-2 Koliyanur, Panruti, Me Mathur, Vanur and Lower Anaicut 10 each, Budalur, Manjalaru, Thammampatty, Dharapuram, Kilanilai, Uthukuli, Kuppanatham, Kilacheruvai, Mohanur, Rasipuram, Rscl-2 Kedar, Kattumayilur, Tozhudur, Pelandurai, Rscl-2 Valavanur, Cuddalore, Dindigul and Mgr Nagar 9 each, Palladam, Dscl Rishivandhiyam, Lakkur, Perambur, Marakkanam, Anna Uty ARG, Thirukalukundram, Thiruchuzhi, Maduranthagam, Uthagamandalam, Ayyampettai, K. paramathi, Tirumayam, Padalur, Thanjavur, Labbaikudikadu, Dc Office Tiruppur, Uthiramerur, Avadi, Arimalam and Kodanad 8 each, Rscl-3 Valathy, Rscl-2 Soorapattu, Dscl Virugavoor, Kundadam, Dscl Thiyagadurgam, Nkl Collectorate, Dscl Kalayanallur, Ponnaniyar Dam, Basl Mugaiyur, Anaippalayam, Rscl-2 Mundiyampakkam, Mavelikara, Taramani ARG, Chettikulam, Mahabalipuram, Chennai AP, Dgp Office, Mettupalayam, Srimushnam, Kamatchipuram, Kodumudi, Sriperumbudur, Karur, Krishnarayapuram, Panchapatti, Viraganur Dam, Puduchatram, Glenmorgan, Pudukottai, Vilupuram, Veeraganoor, Karaikudi, Tirukattupalli, Avinasi, Mulanur, Ambathur, Chembarabakkam, Ponneri, Poonamallee, Vandavasi, Nannilam, Musiri, Tindivanam, Aruppukottai and Poonamalle ARG 7 each
13 Nov	Uthiramerur 17, Kodumudi and Kavali 12 each, Tindivanam and Maduranthagam 11 each, Tiruthani, Tiruttani PTO, Kandukur, Shoolagiri, Alangayam and Natrampalli 10 each, Kodaikannal Boat Club, Uthukottai, Chembarambakkam ARG and Chinnakalar 9 each, Tirupattur, Andipatti, Poonamalle ARG, Rscl-3 Semmedu, Madathukulam, Satyavedu and Cholavaram 8 each, Jamunamarathur, Tcs Mill Kethandapatti, Taramani ARG, Valparai Pap, Cincona, Kuppam, Valparai Taluk Office, Palani, Kodaikanal, Gingee and Chengalpattu 7 each
14 Nov	Nellore and Kavali 12 each, Uthukottai 9, Valinokam 7
15 Nov	Konni 11, Mahabalipuram 9, Mancompu, Kochi C.i.a.l., Kakkayam AWS, Konni ARG, Kulasekarapattinam, Car Nicobar and Lower Kothaiyar ARG7 each
16 Nov	Rajapalayam 12, Ayikudi 9, Nancowry 8, Sivagiri 7
17 Nov	Long Island 7
18 Nov	Mavelikara 10, Konni and Shencottah 9 each, Kayamkulam ARG 7
19 Nov	Nil
20 Nov	Nil
21 Nov	Nil
22 Nov	Nil
23 Nov	Sullurpeta, Tada and Satyavedu 9 each
24 Nov	Thamaraipakkam 10, Kancheepuram 7
25 Nov	Nil
26 Nov	Nil
27 Nov	Rapur and Maya Bandar 7 each
28 Nov	Kurudamannil 15, Alwaye PWD 8, Perumpavur, North Paravur AWS, Kottayam and Konni 7 each
29 Nov	Kannimar 12, Punalur and Konni 11 each, Piravam 9, Bhoothapandy 8, Thodupuzha, Vellarikkundu AWS, Thuckalay, Vadakkancherry, Manjalar and Sothuparai 7 each
30 Nov	Srivilliputhur 7
1 Dec	Kodiayakarai 8
2 Dec	Nil
3 Dec	Pilavakkal 9
4 Dec	Muvattupuzha ARG 7
5 Dec	Thanjavur 16, Needamangalam 14, Lower Anaicut 12, Valangaiman, Nannilam and Kulasekarapattinam 11 each, Tiruvaiyaru 10, Konni, Manalmedu, Jayamkondam, Arantangi, Kodavasal, Mannargudi, Kumbakonam and Manjalaru 9 each, Pandavaiyar Head, Tiruvarur, K.m.koil, Vallam, Thanjavur PTO, Kollidam, Thirumanur and Sirkali 8 each, Nagapattinam, Neivasal Thenpathi, Budalur, Adirampatnam, Pechiparai, Ayyampettai, Kilanilai, Velankanni and Thanjai Papanasam 7 each
6 Dec	Long Island 14

TABLE 5 (*Contd*.)

Date	Some representative amounts of rainfall in cm for October, November and December 2022 (5 cm and above)
7 Dec	Long Island 9
8 Dec	Nil
9 Dec	Chennai AP, Chennai(n), Cd Hospital Tondaipet and Madavaram AWS 7 each
10 Dec	Vembakkam 25, Srikalahasti 23, Thottambedu 22, Kodurand Gudur 20, Kancheepuram 19, Nagari and Cheyyar 18 each, Avadi and Venkatagiri 17 each, Sullurpeta and Kvk Kattukuppam ARG 16 each, Ayanavaram Taluk Office 15, Uthiramerur, Perambur and Arakonam 14 each, Pallipattu, Cholavaram, Sriperumbudur, Gummidipoondi, Mgr Nagar, Mahabalipuram, Tambaram, Satyavedu, Alandur, Nellore, Tirupati AP and Uthukottai 13 each, Koratur, Chengalpattu, Tada, Rapur, Red Hills, Ambathur and Chennai AP 12 each, Ponneri, Poonamallee, Tiruvallur, Poondi, Chembarabakkam, Kaveripakkam, Nungambakkam, Maduranthagam, Cd Hospital Tondaipet, Hindusthan University and Dgp Office 11 each, Tiruttani PTO, Thamaraipakkam, Anna University, Puzhal ARG, Chinnakalar, Poonamalle ARG and Tiruthani 10 each, Chennai Collectorate Bu, Sholinganallur, Vandavasi, Walajabad, Madavaram AWS and Thiruvalangadu 9 each, Jamunamarathur, Kodaikanal, Rajampet and Palasamudram 8 each, Kavali, Arcot, Pullampeta, Satyabama Uty ARG, R.k.pet, Cincona and Atmakur 7 each
11 Dec	Atmakur 13, Palluruthy ARG 11, Amalapuram, Markapur and Yercaud 10 each, Mancompu, Kandukur, Vadapudupattu and Veligandla 9 each, Ambur, Kochi IAF, Kolar G.f., Marripudi, Ongole and Udayagiri 8 each, Thambalapalle, Arcot, Chintamani, Konakanamitla, Wallajah, Ammoor (walajah Railway, Vyanthala ARG, Venkatagiri Kota, Podili, Piravam, Ernakulam South, Arogyavaram, Avanigada, Penagaluru and Rayalpadu 7 each
12 Dec	Alwaye PWD 12, Kandukur and Vyanthala ARG 11 each, Tiruvallur, Chinnakalar, Quilandi and Enamakkal 9 each, Perumpavur, Irinjalakuda, Yerragondapalem, Pattukottai, Bheemunipatnam, Kodungallur, Thritla and Kannur 8 each, Kunnamkulam, Marripudi, Vellanikkara, Kozhikode, Virudachalam, Palacode, Veeraganoor, Karipur Ap., Marakkanam and Thottambedu 7 each
13 Dec	Arogyavaram, Kancheepuram, Barur, Pulipatti and Thanjavur 9 each, Cheyyur, Maduranthagam and Karambakudi 8 each Uthiramerur 7
14 Dec	Needamangalam 16, Thirumanur 15, Coonoor and Coonoor PTO 14, Tiruvaiyaru, Adar Estate and Billimalai Estate 10 each, Burliar and Kodanad 9 each, Basl Manampoondi, Somwarpet and Budalur 8 each, Ketti, Basl Mugaiyur, Rscl-2 Kedar, Sanivarsante and Arantangi 7 each
15 Dec	Kanjirappally and Kozhikode 7 each
16 Dec	Nancowry 10
17 Dec	Nil
18 Dec	Nil
19 Dec	Nil
20 Dec	Nil
21 Dec	Nil
22 Dec	Nil
23 Dec	Nil
24 Dec	Nil
25 Dec	Nil
26 Dec	Nil
27 Dec	Nil
28 Dec	Papanasam 12
29 Dec	Nil
30 Dec	Nil
31 Dec	Nil

Under *La Nina* conditions and favourable synoptic situations such as formation of a low pressure area over the westcentral Bay of Bengal off Andhra Pradesh coast during 3rd - 4th October, formation of Cyclonic Storm, 'Sitrang' over Bay of Bengal and its northward movement towards Bangladesh coast during 22-24 October,

formation of upper air cyclonic circulations over the Bay of Bengal and their westward movement across peninsular India and east-west shear zone across peninsular India in the lower tropospheric levels, extended the southwest monsoon over the Indian region upto 23rd October, resulting in the monthly rainfall for the country being excess (148% of L.P.A.). Similarly, the rainfall over homogeneous region of Northwest India (64.3 mm) was 7th highest since 1901 after the years 1956 (149.9 mm), 1955 (148.5 mm), 1917 (102.2 mm), 1985 (92.7 mm), 1903 (72.7 mm) and 2021 (66.5 mm).

In the first week of October, a low pressure area formed over westcentral Bay of Bengal and neighbourhood along with its associated cyclonic circulation extending up to mid-tropospheric levels tilting southwestwards with height. Persistence of this system close to Andhra Pradesh coast, an east-west trough in the lower tropospheric levels from central Bay of Bengal to south Peninsula, caused rainfall/thunderstorms over Coastal Andhra Pradesh, Odisha, Chhattisgarh, Telangana, Rayalaseema, Karnataka and Kerala. A trough extending up to mid tropospheric levels ran from the cyclonic circulation associated with the low pressure area over westcentral Bay of Bengal and neighbourhood to Bangladesh supported enhanced moisture incursion from Bay of Bengal over east and adjoining areas of Northeast India causing fairly widespread to widespread rainfall /thunderstorms over this region.

A cyclonic circulation over south coastal Andhra Pradesh and neighbourhood with vertical extension up to mid-tropospheric levels, a trough from Gujarat to Haryana at lower levels, a trough from Kerala to Marathwada which ran up to southwest Madhya Pradesh and western disturbances in mid and upper levels, all together resulted in immense rainfall over the country in the second week of October, leading to the weekly rainfall departure to be 177% above normal and 26 sub divisions recording *large excess* rainfall.

Similarly, a cyclonic circulation over westcentral and adjoining southwest Bay of Bengal, off south Andhra Pradesh-north Tamil Nadu coasts, another cyclonic circulation over southeast Arabian Sea and adjoining Kerala coast, a trough from southeast Arabian Sea to southwest Bay of Bengal across extreme Southern Peninsula and a trough from the cyclonic circulation over north Andaman sea and neighbourhood to Tamil Nadu coast across south Bay of Bengal in the lower tropospheric levels caused fairly widespread to widespread rainfall /thunderstorms particularly over south peninsular region and adjoining sub divisions of central India in the third week of this month.

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

Station	*24 hours record rainfall in October 2022(mm)#*	*Date*	*Previous rainfall record(mm)*	*Date*
Ziro	82.0	25.0	49.0	24-10-1970
Itanagar	135.4	10.0	94.1	08-10-2009
Bomdila	122.4	25	80.8	10-10-1975
Aligarh	162.8	9.0	76.6	01-10-1977
Basti	116.0	6.0	90.2	05-10-1996
Najibabad	174.0	10.0	114.5	11-10-1983
Budaun	98.0	9.0	93.0	04-10-2013
Etawah	91.0	8.0	46.6	19-10-1987
Gonda	357.6	6.0	259.6	06-10-1970
Hamirpur	108.0	10.0	81.5	10-10-1985
Fursatganj	87.2	6.0	73.0	14-10-2014
Narnaul	57.0	9.0	33.4	10-10-1974
Sangrur	26.5	11.0	24.1	09-10-1980
Palam	63.9	9.0	52.0	03-10-2004
Alwar	98.0	9.0	40.5	07-10-1985
Shivpuri	124.0	8.0	83.0	09-10-1985
Chamarajanagar	78.4	14.0	62.0	23-10-2005
Mandya	171.8	15.0	112.5	02-10-2000

Source : Climate Summary for the month of October 2022

3.1.5. *Temperature*

The average minimum temperatures and mean temperatures were *normal*, but the departures from mean were higher by 0.49 °C and 0.23 °C, respectively, while the average maximum temperatures were less than mean by 0.03 °C for the country as a whole in the month of October and no *heat wave/cold wave* conditions occurred. The month's and the season's highest maximum temperature of 37.5 °C was recorded at Bhuj (Saurashtra and Kutch) on 24th October and the lowest minimum temperature of the month was reported at 10.5 °C at Sikar (east Rajasthan) on 25th October over the plains of the country.

3.1.6. *Damages associated with disastrous weather events*

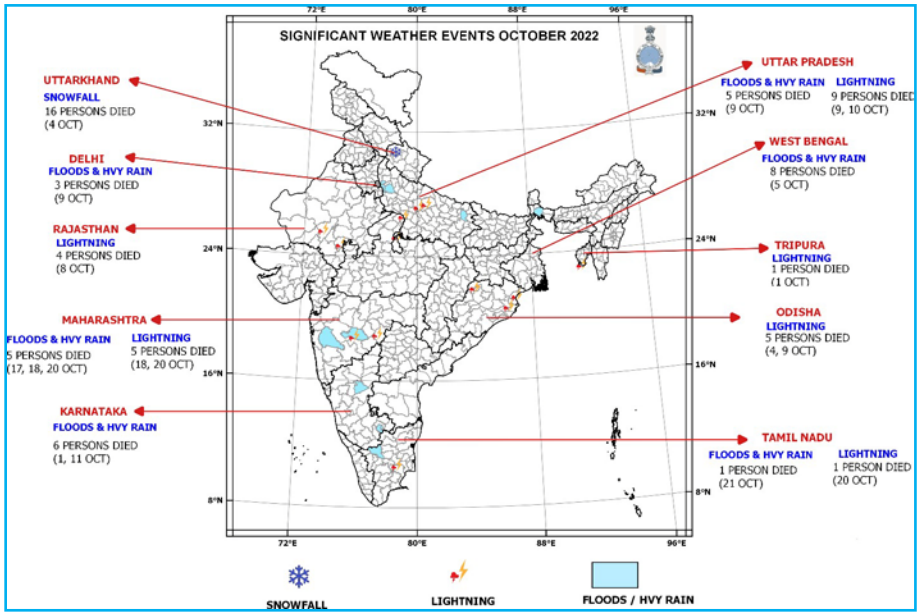
The figure below shows significant weather events and damage or causalities caused there off during the

month of October (based on real time media reports and other state government agencies). Total 69 persons reportedly claimed dead, more than 75 persons injured, more than 15 persons missing and 16 livestock perished during this month.

Floods, heavy rains and landslide : Total 28 persons reportedly claimed dead and more than 28 persons injured, during October, due to floods, heavy rains and landslides.

Lightning : Total 25 persons reportedly claimed dead, 50 persons injured and 16 livestock perished, during October, because of lightning.

Snowfall : 16 persons reportedly claimed dead and 15 others missing due to a snow avalanche in Uttarkashi district of Uttarakhand on 4th October.



Source : IMD, Climate Summary for the month of October 2022

3.2.2. *Weather and associated synoptic features*

A summary of the synoptic systems for the month of November 2022 are given in Table 3. The sub-divisionwise percentage departure of rainfall from normal and the significant amount of rainfall during the month are given in Tables 1 and 5, respectively. The monthly precipitation over the homogenous regions of East & Northeast India and Central India were *large deficient* with rainfall of only 2% and 3%, respectively each, making East and Northeast India monthly rainfall the lowest since 1901, while for the homogeneous region of Central India it was the fifth lowest since 1901. The monthly rainfall over the homogenous region of South Peninsula (78% of L.P.A.) and the country (63% of L.P.A.) as a whole were *deficient*, while the precipitation over the homogenous region of Northwest India was *excess* at 126% of L.P.A. In this region, though only the sub division of Jammu, Kashmir and Ladakh received *large excess* rainfall, Himachal Pradesh sub division recorded *normal* rainfall while the remaining seven sub divisions received *large deficient* or *no rainfall*.

A cyclonic circulation lay over southwest Bay of Bengal and adjoining equatorial Indian Ocean on 8th November and under its influence, a Low Pressure area formed over the same region with the associated cyclonic circulation extending upto 7.6 km above m.s.l. on 9th November which intensified to a Well Marked Low Pressure area over southwest Bay of Bengal off Tamil Nadu coast on 11th morning causing fairly widespread to widespread heavy rainfall /thunderstorms over Tamil Nadu, Puducherry, Karaikal, Lakshadweep islands and isolated to scattered rainfall /thunderstorms over Kerala, Mahe; South Interior Karnataka, Rayalaseema and Coastal Karnataka. The low pressure became less marked on 14 and its associated cycir became less marked on 19th November.

Disturbances in the westerly wind regime affected only the northern most parts of the country, particularly the Jammu, Kashmir & Ladakh sub-division which was the lone sub-division that recorded *large excess* precipitation in this month.

3.2.3. *Temperature*

Cold day and *Cold wave* conditions were not observed in this month.

In November 2022, the average maximum temperature, average minimum temperature and mean temperature were normal but the departures from normal were 0.34 °C, 0.29 °C and 0.31 °C respectively for the country as a whole. The maximum temperature over East & Northeast India (29.06 °C with an anomaly of 1.27 °C) was the highest since 1901. The lowest minimum temperature of 4.1 °C was reported at Churu (west Rajasthan) on 24th November over the plains of the country.

3.2.4. *Damages associated with disastrous weather events*

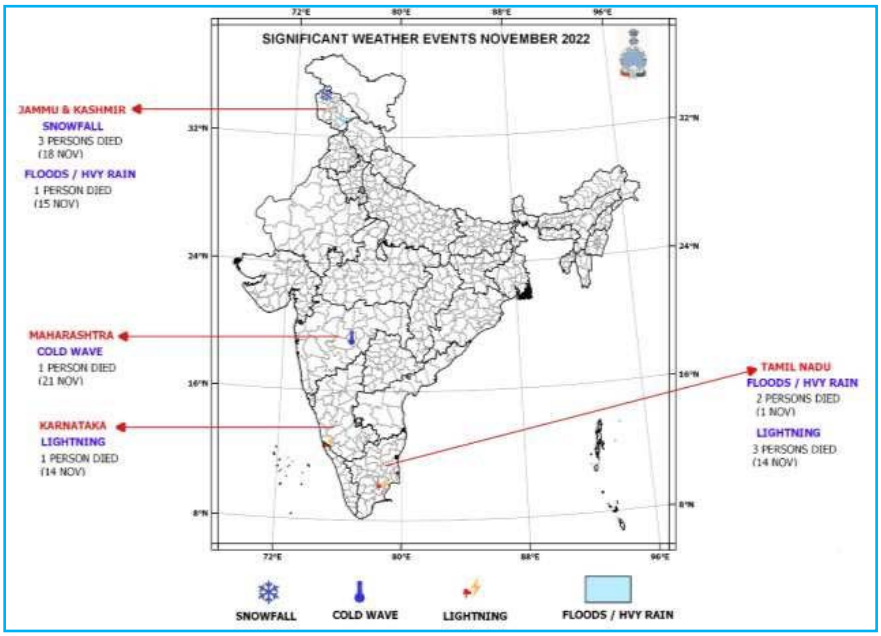
During November, a total of 10 persons were reportedly claimed dead. The details of causalities are depicted in the figure below, which are based on real-time media reports and other state government agencies

Floods, heavy rains and landslides : A total of 3 persons reportedly claimed dead during November, due to floods, heavy rains and landslides

Lightning : A total of 4 persons reportedly claimed dead during November, because of Lightning. The details of the area affected by the events are summarized and given in the table below;

Snowfall : 3 Indian Army personnel of 56 Rashtriya Rifles reportedly claimed dead due to a snow avalanche in the Kupwara district of Jammu & Kashmir on 18th November.

Below normal temperatures : 1 person reportedly claimed dead due to below normal temperatures in the Parbhani district of Maharashtra on 21st November.



Source : IMD, Climate Summary for the month of November 2022

3.3. *December*

3.3.1. *Storms and depressions*

A remnant upper air cyclonic circulation from south China Sea under favourable conditions, under its influence, a Low Pressure area formed over South Andaman Sea and neighbourhood in the morning (0530 hours IST) of 5th December, it became a Well Marked Low Pressure area in the morning (0530 hours IST) of 06th December. Under favourable environmental conditions, the Well Marked Low Pressure concentrated into a Depression in the evening (1730 hours IST) of 6th December. It moved west-northwestwards and intensified further into a Deep Depression on 7th December, continuing to move west-northwestwards, it further intensified into the Cyclonic Storm "Mandous" over southwest Bay of Bengal around midnight (2330 hours IST) of 7th December and into a Severe Cyclonic Storm in the evening (1730 hours IST) of 8th December.

Encountering unfavourable environment [moderate to high wind shear, interaction with land surface, relatively colder sea and lower Ocean heat content (less than 50 K Joules/second)] and weakened into a Cyclone over southwest Bay of Bengal off north Tamilnadu and Puducherry coasts in the morning (0530 hours IST) of 9th December and crossed north Tamil Nadu, Puducherry coasts and adjoining south Andhra Pradesh coasts, resulting in severe weather activity over southern peninsula especially over Tamil Nadu, Puducherry, Karaikal and Rayalaseema. The remnant cyclonic circulation of the severe cyclonic storm, "Mandous" emerged into the Arabian Sea and with time developed into a Deep Depression over eastcentral Arabian Sea at 0530 hours IST of 15th December. Under its influence widespread rainfall /thunderstorms along with isolated heavy rainfall occurred over Kerala & Mahe, scattered rainfall /thunderstorms over Lakshadweep islands and isolated rainfall over parts of Karnataka and Maharashtra. Owing to these systems, the Northeast Monsoon was *vigorous* over coastal Andhra Pradesh, Rayalaseema; and active over Tamil Nadu, south interior Karnataka on 10th, vigorous over coastal Andhra Pradesh, Rayalaseema, south interior Karnataka, Kerala on 11th and 12th, *vigorous* over Rayalaseema, south interior Karnataka, Kerala and active over Tamil Nadu on 13th *vigorous* over south interior Karnataka and *active* over Tamil Nadu on 14th December.

The last intense system of the season formed under the influence of the cyclonic circulation over south Andaman Sea, adjoining strait of Malacca and Sumatra. A Low Pressure area formed over equatorial Indian Ocean and adjoining areas of south Andaman Sea and southeast Bay of Bengal on 14th December. It persisted over the same region during 15th to 17th December, moved slowly westwards during 18th to 20th December and became a Well-Marked Low Pressure area over Southwest Bay of Bengal and adjoining East Equatorial Indian Ocean on 21st December. It concentrated into a Depression at 0830 hours IST of 22nd December over southwest and adjoining southeast Bay of Bengal, this system moved slowly and recurved east-northeastwards and made a clockwise loop and then moved west-northwestwards and reached Southwest Bay of Bengal and started to recurve slowly west-southwestwards towards Sri Lanka coast. It crossed Sri Lanka coast to the south of Trincomalee as a Depression with maximum sustained wind speed of 45-55 kmph gusting to 65 kmph during 1230 to 1330 hours IST of 25th December. Thereafter, the system continued to move west-southwestwards and weakened into a Well Marked Low Pressure area over Sri Lanka, then emerged into Comorin area and became less marked over the Maldives and adjoining Lakshadweep area. In the formative stages of this system rainfall /thunderstorms occurred over Andaman and Nicobar Islands, while light to moderate rainfall was reported in south Tamil Nadu and south Kerala on 22nd, 23rd, 25th and 26th December.

3.3.2. *Weather and associated synoptic features*

Table 4 gives a summary of the synoptic systems during the month of December 2022. The sub-division wise percentage departure of rainfall from normal and the significant amounts of rainfall during the month are given in Tables 1 and 5, respectively.

The monthly rainfall of December was large deficient over the homogenous regions of Northwest India (17% of L.P.A.) and Central India (23% of L.P.A.), were deficient, over East & Northeast India (46% of L.P.A.), while the monthly precipitation over South Peninsula was large excess being 179% of normal, which was the second highest since 2001 after the year 2010. In this month 6 sub divisions recorded large excess rainfall (all from south peninsula), 2 sub divisions were excess, 3 sub divisions normal, 4 sub divisions deficient, 18 sub divisions (52% of the country) large deficient and 3 sub divisions with no rainfall.

In the first week of December, movement of a trough in low level easterlies caused fairly widespread to widespread rainfall /thunderstorms over Tamil Nadu, Puducherry, Karaikal, Kerala, Mahe and Lakshadweep islands. During December, western disturbances caused some rainfall activity over the north Indian region or snowfall over western Himalayan region but mostly these systems were feeble or located north of 28-30° N and did not affect the region, drastically reducing the precipitation.

3.3.2. *Temperature*

In December 2022, the average maximum temperature, average minimum temperature and mean temperature were more than normal by 0.79 °C, 1.21 °C and 1.00 °C respectively for the country as a whole. All India mean temperature was the highest (21.49 °C with an anomaly of 1.0 °C) since 1901 and the maximum temperature was the second highest (27.32 °C with an anomaly of 0.79 °C) after the year 2016 (27.75 °C) while the minimum temperature was also the second highest (15.65 °C with an anomaly of 1.21 °C) after the year 2008 (15.69 °C) since 1901.

Cold wave conditions were observed over Northwest India from the second fortnight of December they intensified to Severe Cold waves in the last few days of the month over sub divisions of Punjab, Haryana, Rajasthan and Himachal Pradesh. Severe Cold day/Cold day conditions were observed over most of the sub divisions of Northwest India in the second fortnight of the month. The lowest minimum temperature for the month

and the season was 0.0°C reported at Churu (west Rajasthan) on 26 December over the plains of the country.

Some stations recorded the highest maximum temperature for the month. A list of such stations is given below with their previous record and date.

Station Name	New Record (°C)#	Date (Dec 22)	Previous Record (°C)	DD/MM/YYYY
Guwahati AP	30	1	29.7	01-12-2015
North Lakhimpur	31.4	1	31.3	01-12-2002
Shillong*	23.2	5	22.5	15-12-1978
Cooch Behar AP	31.6	1	31	09-12-2016
Jharsugda AP	33	15	32.4	07-12-2006
Ranchi AP	29.8	12	28.8	14-12-2008
Medikeri*	31.2	4,5	29	27-12-2007

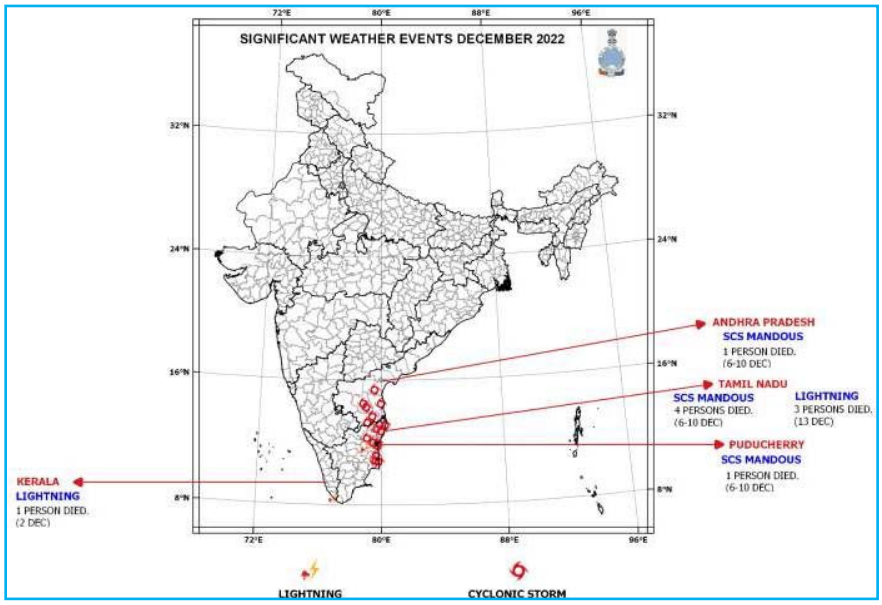
(# based on real-time available data) * Indicates hill station

3.3.3. *Damages associated with the Disastrous weather events*

During December, total 10 persons reportedly claimed dead due to cyclonic storm and lightning. The figure below shows significant weather events during the month (based on real time media reports.)

Cyclonic Storm : Total 6 persons reportedly claimed dead during December, because of Severe Cyclonic Storm "MANDOUS".

Lightning : Total 4 persons reportedly claimed dead during December, because of Lightning.



Source : IMD, Climate Summary for the month of December 2022

The inputs received from the office of the Director General of Meteorology (Hydromet), New Delhi is duly acknowledged. Thanks are due to Smt. P. P. Kulkarni, Met A., Weather Forecasting Division, Pune for her assistance.

Appendix

Definitions of the terms given in '*Italics*'

(A) Rainfall

(*i*) Percentage departure from normal

Large Excess	- + 60% or more
Excess	- +20% to +59%
Normal	- –19% to +19%
Deficient	- –20% to –59%
Large Deficient	- –60% to –99%

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

Extremely heavy rainfall	- 20.5 cm and above
Very heavy rainfall	- 11.6 cm to 20.4 cm
Heavy rain	- 6.5 cm to 11.5 cm

Heavy snowfall - 64.5 cm to 115.5 cm

(*iii*) Spatial distribution (percentage of the stations in a meteorological sub-division reporting a 24 hour rainfall of 0.1 mm or more)

At most places (Widespread) - 76% of stations gets rainfall

At many places (Fairly widespread) - (51-75)% of stations gets rainfall

At a few places (Scattered) - (26-50)% of stations gets rainfall

At isolated places (Isolated) - ≤25% of stations gets rainfall

(B) Monsoon activity

(*i*) Southwest monsoon

Vigorous - Rainfall exceeding 4 times the normal with, at least two stations reporting rainfall more than or equal to 8 cm along the west coast and 5 cm elsewhere. Rainfall in that sub-division should be fairly widespread or widespread

Active - Rainfall more than 1½ to 4 times the normal, with at least two stations reporting rainfall more than or equal to 5 cm along the west coast and 3 cm elsewhere. Rainfall in that sub-division should be fairly widespread or widespread

(*ii*) Northeast monsoon

Vigorous - Rainfall exceeding 4 times the normal with at least two stations reporting rainfall more than or equal to 5 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 3 cm elsewhere in the northeast monsoon region. Rainfall in that sub-division should be fairly widespread or widespread

Active - Rainfall more than 1½ to 4 times the normal, with at least two stations reporting rainfall more than or equal to 3 cm in coastal Tamil Nadu and south coastal Andhra Pradesh and 2 cm elsewhere in the northeast monsoon region. Rainfall in that sub-division should fairly widespread or widespread

(C) Temperatures

(*i*) Maximum / Day temperature

Markedly above normal - When departure from normal is +5 °C or more

Appreciably above normal - When departure from normal is +3.1 °C to +5.0 °C

Above normal - Departure from normal is +1.6 °C to +3.0 °C

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

(*ii*) Minimum / Night temperature

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

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

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

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

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

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

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

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