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Weather in India

WINTER SEASON (January-February 2023)†

1. Introduction

In the winter season 2023, January experienced *severe cold waves* and *cold waves* in Northwest and adjoining Central India, while in February there was an anomalous rise in temperatures particularly over North and Central India.

The Northeast monsoon rains ceased over Tamil Nadu, Puducherry, Karaikal, Kerala, Mahe, adjoining areas of coastal Andhra Pradesh, Yanam, Rayalaseema and South interior Karnataka with effect from 12th January 2023.

The precipitation over the country and the homogenous regions for the season and both the months were less than normal except in January when the homogenous region of Northwest India received 129% of long period average (LPA) rainfall.

The core of Sub-Tropical Westerly Jet (STWJ) was seen between Latitude 24°N and 29°N all through the season. *Very dense* to *dense fog* was observed over Northwest India on many days during the month of January.

In a rare occurrence, one Depression formed at the end of January over the Bay of Bengal during the season.

2. Seasonal Rainfall (January-February)

The seasonal rainfall over the country as a whole was below normal with precipitation of 56% of LPA. Similarly, the rainfall/snowfall over all the four homogenous regions too was less than normal.

The monthly and seasonal sub-divisional rainfall (actual, normal and percentage departure) are presented in Table 1. Also, representative amount of rainfall on a day-to-day basis are presented in Table 4. The percentage departure falling under various categories, *viz.*, *large excess*, *excess*, *normal*, *deficient*, *large deficient* and *no rain* are shown in Fig. 1. Out of the 36 meteorological sub-divisions of India, the seasonal rainfall was *large excess* in 2, *excess* in 1, *normal in 2*, *deficient* in 9 sub-divisions, *large deficient* in 19 sub-divisions and *no rain* in 3 sub-divisions.

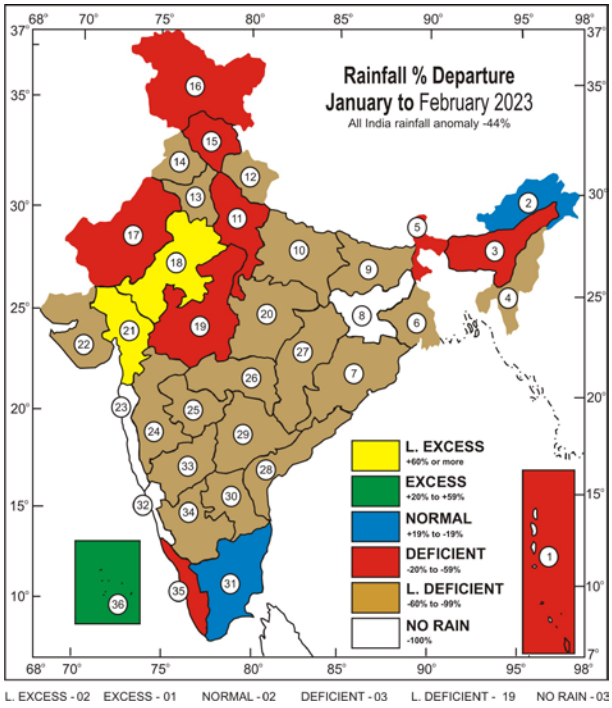

Fig. 1. Sub-divisionwise seasonal rainfall departure from normal (%) for post monsoon season (January to February, 2022). Sub-divisions are indicated by number on the map & bold letters in legend. The rainfall anomaly values for these 36 sub-divisions are indicated below :

1	-36	**7**	-99	**13**	-63	**19**	-54	**25**	-91	**31**	-17
2	-18	**8**	-100	**14**	-68	**20**	-87	**26**	-97	**32**	-100
3	-47	**9**	-99	**15**	-38	**21**	102	**27**	-99	**33**	-95
4	-98	**10**	-83	**16**	-22	**22**	-60	**28**	-94	**34**	-77
5	-33	**11**	-56	**17**	-39	**23**	-100	**29**	-98	**35**	-28
6	-99	**12**	-63	**18**	110	**24**	-99	**30**	-98	**36**	33

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

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TABLE 1

Sub-division wise rainfall (mm) for each month and season as a whole (January - February 2023)

S. No.	Meteorological Sub-divisions	January			February			Season		
		Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)	Actual (mm)	Normal (mm)	Dep. (%)
1.	A. & N. Islands	27.4	56.4	-51%	23.8	23.7	0%	51.1	80.1	-36%
2.	Arunachal Pradesh	10.9	45.8	-76%	98.5	87.3	13%	109.4	133.1	-18%
3.	Assam & Meghalaya	0.4	13.8	-97%	21.8	28.3	-23%	22.2	42.1	-47%
4.	Naga., Mani., Mizo. and Tri.	0.1	10.4	-99%	0.7	21.5	-97%	0.7	31.9	-98%
5.	Sub-Himalayan West Bengal & Sikkim	0.2	15.3	-99%	29.1	28.3	3%	29.3	43.6	-33%
6.	Gangetic West Bengal	0.1	12.7	-99%	0.2	16.6	-99%	0.3	29.3	-99%
7.	Orissa	0.1	10.6	-99%	0.0	14.5	-99%	0.1	25.1	-99%
8.	Jharkhand	0.0	11.0	-100%	0.0	14.4	-100%	0.0	25.4	-100%
9.	Bihar	0.2	9.4	-98%	0.0	10.4	-100%	0.2	19.8	-99%
10.	East Uttar Pradesh	4.3	12.1	-65%	0.0	13.1	-100%	4.3	25.2	-83%
11.	West Uttar Pradesh	13.6	12.9	5%	0.0	17.6	-100%	13.6	30.5	-56%
12.	Uttarakhand	30.6	42.2	-28%	6.6	59.5	-89%	37.2	101.7	-63%
13.	Haryana, Chandigarh & Delhi	11.8	14.6	-19%	0.0	17.4	-99%	11.8	32.0	-63%
14.	Punjab	15.1	20.3	-26%	0.1	27.1	-99%	15.2	47.4	-68%
15.	Himachal Pradesh	86.8	85.3	2%	29.5	101.8	-71%	116.3	187.1	-38%
16.	Jammu & Kashmir and Ladakh	135.1	95.1	42%	40.8	130.4	-69%	175.8	225.5	-22%
17.	West Rajasthan	5.2	3.1	68%	0.0	5.4	-100%	5.2	8.5	-39%
18.	East Rajasthan	22.8	5.0	357%	0.0	5.9	-100%	22.8	10.9	110%
19.	West Madhya Pradesh	6.5	6.9	-6%	0.0	7.1	-100%	6.5	14.0	-54%
20.	East Madhya Pradesh	4.2	15.8	-73%	0.0	17.6	-100%	4.2	33.4	-87%
21.	Gujarat Region	3.0	1.0	202%	0.0	0.5	-100%	3.0	1.5	102%
22.	Saurashtra & Kutch & Diu	0.3	0.4	-19%	0.0	0.4	-100%	0.3	0.8	-60%
23.	Konkan & Goa	0.0	0.4	-100%	0.0	0.2	-100%	0.0	0.6	-100%
24.	Madhya Maharashtra	0.0	1.5	-99%	0.0	1.3	-100%	0.0	2.8	-99%
25.	Marathawada	0.6	4.0	-86%	0.0	2.4	-100%	0.6	6.4	-91%
26.	Vidarbha	0.5	9.9	-95%	0.0	7.0	-100%	0.5	16.9	-97%
27.	Chhattisgarh	0.1	12.1	-99%	0.0	9.8	-100%	0.1	21.9	-99%
28.	Coastal Andhra Pradesh & Yanam	1.4	9.7	-86%	0.0	12.5	-99%	1.4	22.2	-94%
29.	Telangana	0.4	9.3	-96%	0.0	6.7	-100%	0.4	16.0	-98%
30.	Rayalaseema	0.2	4.0	-95%	0.0	4.8	-100%	0.2	8.8	-98%
31.	Tamil Nadu, Pudcherry & Karaikal	5.1	12.3	-59%	15.6	12.5	24%	20.6	24.8	-17%
32.	Coastal Karnataka	0.0	1.7	-100%	0.0	1.3	-100%	0.0	3.0	-100%
33.	North Interior Karnataka	0.2	2.6	-91%	0.0	1.8	-100%	0.2	4.4	-95%
34.	South Interior Karnataka	1.3	2.1	-36%	0.0	3.6	-100%	1.3	5.7	-77%
35.	Kerala & Mahe	12.8	7.4	72%	2.4	13.7	-83%	15.1	21.1	-28%
36.	Lakshadweep	33.4	15.8	111%	1.0	10.0	-90%	34.4	25.8	33%

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

TABLE 2

Details of the weather systems during January 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 Jan (0300 UTC) - 2 Feb (1800 UTC)	Southeast and adjoining southwest Bay of Bengal	West	Comorin and adjoining Gulf of Mannar and west coast of Sri Lanka	Initially, it lay as a lay as a cyclonic circulation over east equatorial Indian ocean and adjoining southeast Bay of Bengal on 25th. Low pressure area (LP) on 27th morning, Well marked low pressure (WMLP) on 29th morning. The Depression weakened to WMLP on 2nd Feb, into a LP on 3rd February evening became less marked on 1200 UTC of 4th and the associated cyclonic circulation became less marked on 5th February
(**B**) *Western disturbances /Eastward moving systems*						
(*i*) *Upper air cyclonic circulation*						
1.	At 5.8 kms a.s.l.	21-25	Afghanistan and neighbourhood	Northeast	North Pakistan and adjoining Afghanistan	Initially, it lay as a lay as a cyclonic circulation over west Iran and neighbourhood between 5.8 and 7.6 km above m.s.l. on 18th lay as a trough in middle tropospheric westerlies with its axis at 5.8 km above m.s.l. roughly along Long. 70°E to the north of Lat. 32°N on 26th which moved away northeastwards on 27th
(*ii*) *As a trough*						
1.	At 5.8 km above m.s.l.	2-4	Roughly along Long. 65°E to the north of Lat. 30°N	East northeast	Roughly along Long. 78°E to the north of Lat. 28°N	Moved away east northeastwards on 5
2.	At 5.8 km above m.s.l.	7 mor	Roughly along Long. 90°E to the north of Lat. 24°N	-		Became less marked on 7
3.	At 5.8 kms a.s.l.	6-10	Roughly along Long. 55°E to the north of Lat. 30°N	East northeast	Roughly along Long. 70°E to the north of Lat. 32°N	Initially, it lay as a lay as a cyclonic circulation over east Iran and neighbourhood between 3.1 and 5.8 km above m.s.l. on 5th. Moved away east northeastwards on 11
4.	At 5.8 kms a.s.l.	11-14	Roughly along Long. 50°E to the north of Lat. 30°N	Do	Roughly along Long. 75°E to the north of Lat. 32 °N	Moved away east northeastwards on 15
5.	At 5.8 kms a.s.l.	17-20	Roughly along Long. 64°E to the north of Lat. 28°N	Do	Roughly along Long. 72°E to the north of Lat. 30°N	It lay as a cyclonic circulation over north Pakistan and neighbourhood between 3.1 km and 4.5 km above m.s.l. over north Pakistan and adjoining Jammu - Kashmir and Ladakh on 21st. Moved away east northeastwards on 22
6.	At 5.8 kms a.s.l.	27 January - 3 February	Roughly along Long. 52°E to the north of Lat. 24°N	East	Roughly along Long. 91°E to the north of Lat. 22°N	Moved away northeastwards on 4 February
(*iii*) *As an induced cyclonic circulation*						
1.	Upto 1.5 kms a.s.l.	11 Mor - 14	Central Pakistan and adjoining neighbourhood	East	Northeast Rajasthan and neighbourhood	Became less marked on 14

TABLE 2 (*Contd.*)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2.	At 1.5 kms a.s.l.	20-25	Southwest Rajasthan and neighbourhood	North northeast	Punjab and neighbourhood	Became less marked on 26
3.	Upto 1.5 kms a.s.l.	29-30	Do	Do	Northwest Rajasthan and neighbourhood	Became less marked on 31
(**C**)	*Other upper air cyclonic circulations*					
1.	Between 1.5 and 3.1 km a.s.l.	7-8	Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 9
2.	At 0.9 km a.s.l	24	North interior Tamil Nadu and neighbourhood	Do	Do	Became less marked on 25
(**D**)	*Other troughs*					
1.	At 1.5 km a.s.l.	4-5	From southeast Uttar Pradesh to west Vidarbha	West	From southeast Madhya Pradesh to north Madhya Maharashtra	Became less marked on 6
2.	At 1.5 km a.s.l.	24-25	From northeast Arabian Sea to southwest Uttar Pradesh	Oscillatory	From west Vidarbha to the cyclonic circulation over Punjab and neighbourhood	Became less marked on 26

3. Monthly features

3.1. *January*

3.1.1. *Storms and Depressions*

The first intense system of the year 2023 formed as a Depression over Southeast and adjoining Southwest Bay of Bengal. A Low Pressure area formed under the influence of the cyclonic circulation over east equatorial Indian ocean and adjoining southeast Bay of Bengal in the morning (0530 hours IST/0000 UTC) of 27th January. It lay as a Well-Marked Low pressure on 29th January and concentrated into a Depression over southeast and adjoining southwest Bay of Bengal at 0300 UTC of 30th January. After moving west-northwestwards, it recurved southwestwards and crossed Sri Lanka coast between Batticaloa and Trincomalee near latitude 7.8°N and longitude 81.6°E on 2nd February. This system caused *light* to *moderate* rainfall at a few places with *heavy to very heavy* rainfall at isolated places over south Tamil Nadu and adjoining south Kerala on 2nd February. It was the first intense cyclonic disturbance in the month of January after 2019 over the Bay of Bengal when cyclonic storm, “Pabuk” emerged from South China Sea into Andaman sea. Similarly, a Depression also had developed on 4th January, 2014 which crossed Sri Lanka coast and weakened over Comorin area.

3.1.2. *Weather and associated synoptic features*

As given in Table 2, 1 Depression, 10 western disturbances (including 1 upper air cyclonic circulation, 6 troughs in westerlies and 3 induced cyclonic circulations), upper air cyclonic circulations and troughs two each, which affected the weather over the country during the month of January.

Western disturbances affected Western Himalayan region and adjoining plains of Northwest India, these systems supported by moisture incursion from Arabian Sea as well as Bay of Bengal caused fairly widespread to widespread rainfall /snowfall /thunderstorms over Jammu - Kashmir & Ladakh, Uttarakhand and Himachal Pradesh. Passage of the induced systems over Rajasthan supported by enhanced moisture incursion caused scattered to fairly widespread rainfall/thunderstorms over Rajasthan, Punjab, Haryana, Chandigarh, Delhi, Gujarat and Madhya Pradesh. This resulted in the monthly precipitation over the homogenous region of Northwest India to be *excess* (129% of L.P.A.).

3.1.3. *Monthly rainfall*

The monthly precipitation over the country was less than normal (87% of L.P.A.) while over the homogenous regions it was *large deficient* except over the homogenous

TABLE 3

Details of the weather systems during February 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**)	*Western disturbances / Eastward moving systems*					
(*i*)	*Upper air cyclonic circulation*					
1.	At 3.1 km above m.s.l.	28	East Afghanistan	-	-	Initially, it lay as a trough in mid & upper tropospheric westerlies with its axis at 5.8 km a.s.l. and along Long. 65° E and to the north of Lat. 32° N on 28th morning. The cycir became less marked on 1 March while the trough above moved away on 3rd March
(*ii*)	*As a trough in westerlies*					
1.	At 3.1 km a.s.l	1-4	Along Long. 55° E to the north of Lat.32° N	Northeast	Along Long. 63° E to the north of Lat. 34° N	Moved away northeastward on 5
2.	At 5.8 km a.s.l	5-6	Along Long. 55° E to the north of Lat.30° N	East	Along Long. 68° E to the north of Lat. 30° N	Moved away east-northeastward on 7
3.	At 5.8 km a.s.l.	9-12	Roughly along Long. 55°E to the north of Lat. 30°N	Do	Roughly along Long. 73°E to the north of Lat. 32°N	It lay as a cyclonic circulation over west Iran and neighbourhood which extended between 5.8 and 7.6 km above m.s.l. on 8th. It moved away northeastward on 13
4.	At 5.8 km a.s.l.	14	Roughly along Long. 68°E to the north of Lat. 35°N	Northeast	-	Moved away northeastward on 15
5.	At 5.8 km a.s.l.	18 Mor - 21	Roughly along Long. 50°E to the north of Lat. 30°N	Do	Roughly along Long. 70°E to the north of Lat. 32°N	Moved away northeastward on 22
6.	At 5.8 km a.s.l.	25 Mor - 27	Roughly along Long. 55°E to the north of Lat. 32°N	East	Roughly along Long. 72°E to the north of Lat. 32°N	Became less marked on 28
(*iii*)	*As an induced cyclonic circulation*					
1.	Upto 1.5 km a.s.l	6	Northwest Rajasthan and neighbourhood	Stationary	*In situ*	Became less marked on 7
2.	Up to 1.5 km above m.s.l.	9-10	Central Pakistan and adjoining west Rajasthan	Northeast	Punjab and neighbourhood	Became less marked on 11
3.	Upto1.5 kms a.s.l.	20-21	Punjab and adjoining Pakistan	East	Haryana and neighbourhood	Became less marked on 22
4.	Up to 1.5 km above m.s.l.	28 Feb	Southwest Rajasthan adjoining south Pakistan	Do	Southeast Rajasthan and adjoining west Madhya Pradesh	Became less marked on 1 March
(**B**)	*Other upper air cyclonic circulations*					
1.	Upto 3.1 km a.s.l	14-16	Tripura and neighbourhood	Stationary	Northeast Bangladesh and neighbourhood	It became less marked on 17.
2.	At 0.9 km above m.s.l.	17	Interior Odisha	West	Chhattisgarh and neighbourhood	Became less marked on 19
3.	At 1.5 km above m.s.l.	25-26	East Bangladesh and neighbourhood	Stationary	*In situ*	Became less marked on 27
4.	At 3.1 km a.s.l.	27	Northeast Bihar and neighbourhood	Do	Do	Became less marked on 28
(**C**)	*Other Troughs/ Wind Discontinuity*					
1.	Between 1.5 km and 3.1 km above m.s.l.	21-23	Roughly along Long. 87°E to the north of Lat. 22°N	East	Roughly along Long. 90°E to the north of Lat. 22°N	Became less marked on 24
2.	At 1.5 km a.s.l.	28	Roughly along Long. 90°E to the north of Lat. 25°N	-	-	Became less marked on 1 March

TABLE 4

Some representative amounts of rainfall in cm for January and February 2023 (3 cm and above)

Date	Some representative amounts of rainfall in cm for January 2023 (3 cm and above)
1 Jan	Nil
2 Jan	Nil
3 Jan	Nil
4 Jan	Nil
5 Jan	Kakinada 4
6 Jan	Nil
7 Jan	Nil
8 Jan	Parangipettai 3
9 Jan	Nil
10 Jan	Nil
11 Jan	Nil
12 Jan	Banihal 3
13 Jan	Nil
14 Jan	Kukernagh, Qazi Gund, Banihal, Batote and Pahalgam 5 each, Awantipur IAF, Govindpura AWS and Shalimar Agro 4 each, Anantnag, Kandaghat, Udhampur (IAF), Simla, Manali, Seo Bagh, Verinag, Gulmarg RS and Badarwah 3 each
15 Jan	Nil
16 Jan	Nil
17 Jan	Nil
18 Jan	Yingkiong 3
19 Jan	Nil
20 Jan	Kothi 3
21 Jan	Kothi and Pahalgam 4 each, Verinag and Ghamroor 3 each
22 Jan	Nil
23 Jan	Nil
24 Jan	Thalaignayer, Tirupoondi, Vedaranyam, Velankanniand Ayikudi 3 each
25 Jan	Nagrota Surian, Saloniand Dehra Gopipur 9 each, Kangra AP, Dharmsala, Gulerand PTO Koksar 7 each, Perumkadavila ARG, Amband Nadaun 6 each, Ghamroor, Chalakudi, Agathi, Gulmarg R.s., Thiruvananthapuram, Suntikoppa, Kurudamannil, Kheri, Gormi, PTO Gondla, Quilandi, Hoshiarpur, Una and Garhshankar ARG 5 each, Sujanpur Tira, Palampur, Udaipur, Una Rampur AWS, Garhshankar, Hoshiarpur AWS, Badarwah, Nawanshahr, Phangota, Chhibramau, Batote, Valparai Pap, Valparai Taluk Office, Taluk Office Pandalur, Mavelikara, Munnar Kseb, RLBbmb, Airport Chakka ARG and Chuari 4 each, Ater, Ranjit Sagar Dam Site, Koppa, Jaswant Nagar, Perumpavur, Malikpur, Balachaur, Pathankot ARG, Nangal, Jakholi, Pathankot IAF, Kayamkulam, Banihal, Chinnakalar, Cincona, Valparai PTO, Worth Estate Cher, Kayathar ARG, Alapuzha, Vaikom, BulIrr, Ottapalam, Konni, Seethathode AWS, Vyanthala ARG, Jhandutta, Bharmaur, Aghar, Hamirpur AWS and Baijnath 3 each
26 Jan	Kheri 9, Badamalhera 7, Badarwah, Pahalgam and Perunchani Dam 5 each, Kukernag, Chhatrari, Vidisha, Gyaraspur, Saloni, Biswan, Puthan Dam, Batote and Gulmarg R.s. 4 each, Poonjar AWS, Malthone, Anantnag, Bijawar, Chahtarpur-aws, Nateran, Verinag, Narmadapuram, Bhopal Arera Hills, Kolar, Ranjit Sagar Dam Site, Phangota, Bangana R, Bangana F, Sangraha, Gund, Chuari, Qazi Gund and Dharmsala 3 each
27 Jan	Nil
28 Jan	Nil
29 Jan	Sahada SR, Bhim, Railmagra SR, Udaipur/D-aero and Radhanpur 3 each
30 Jan	Parbatsar and Amet 8 each, Jawaja 7, Tatgarh SR, Nainwa and Khadrala 6 each, Pushkar SR, Kotkasim SR, Deogarh, Asind, Nayanagar/Beawar, Chothkabarwara SR, Gogunda SR, Wangtoo and Kothi 5 each, Dausa, Nawa, Malpura, Kalpa, Chakrata, Tiuni, Barkot, Nancowry, Sikar, Purola, Dalhousi Alha AWS, Car Nicobar IAF, Bhinay SR, Bhim, Batote, Ajmer Tehsil SR, Ajmer, Sangla, Desuri and Chirawa 4 each, Pusa AWS, Sarahan, Bilara, Jatton Barrage, Kotkhai, PTO Gondla, Manali, Tinder, Banjar, Palam, Taoru, Sohana, Malikpur, Sawai Madhopur, Badarwah, Aya Nagar, Mussoorie, UttarKashi (bar), Pathankot ARG, Uttar Kashi (CWC), Malhargarh, Car Nicobar, Pathankot IAF, Manesar REV, Kapurthala, DhariwalIrr, Rewari, Bawal, Nagina REV, Nuh, Narnaul REV, Narnaul, Ateli, Pooh, Jhadol SR, Chuari, Pisagan SR, Bhopalsagar SR, Nimarana, Kishngarhwas SR, Bahadurpur SR, Behror, Vijaynagar SR, Sarwar, Nasirabad, Bassi, Masuda SR, Mangliawas SR, Kishangarh, Geola SR, Kekri SR, Arai SR, Raipur SR, Jaitran, Baswa, Chaksu, Srinagar, Abu Road SR, Shalimar Agro, Banihal, Raj Pura ARG, Kishtwar, Gulmarg R.s., Mori, Girva SR, Mounntabu Tehsil SR, Sikar Tehsil SR, Jaipur AP, Malerainadunger SR, Bonli, Rajsamand, Nathdwara, Arnod SR, Ladpura SR, Shahpura SR, Naraina SR and Abu 3 each

TABLE 4 (*Contd.*)

Date	Some representative amounts of rainfall in cm for January 2023 (3 cm and above)
31 Jan	Ranjit Sagar Dam Site 8, Udhampur (IAF) and Mori 6 each, Batote, Katra, Gulmarg RS and Veeraganoor 5 each, Samba AWS, Banihal, Raj Pura ARG, Qazi Gund, Shahpur Kandi, Phangota, Bhaderwah ARG and Pahalgam 4 each, Dharmsala, Saloni, Madhopur, Anchal ARG, Srivaikuntam, Verinag, Shalimar Agro, Reasi ARG, Tengmarg, Kukernag, Rajouri, Kupwara, Kishtwar, Jammu, Gund, Badarwah and Govindpura AWS3 each
1 Feb	Kodiayakarai 4, Vedaranyam 3
2 Feb	Vedaranyam 7, Kodiayakarai and Tirupoondi 6 each, Thalaignayer and Nagapattinam 4 each, Karaikal, Kollidam, Velankanni and Pamban 3 each
3 Feb	Needamangalam and Velankanni 10 each, Tiruvarur, Nagapattinam and Nannilam 9 each, Thirukuvalai and Tirupoondi 8 each, Adirampatnam, Devakottai, Ayyampettai, Orthanad, Neivasal Thenpathi, Vettikadu, Kodavasal and Mannargudi 7 each, Thanjavur, Kilanilai, Manamelkudi, Pattukottai, Alangudi, Vedaranyam, Pandavaiyar Head and Karaikal 6 each, Vallam, Peravurani, Manjalaru, Kurungulam, Madukkur, Karaikudi, Thiruthuraipoondi, Nagudi, Thalaignayer, Arantangi, Arimalam, Avudayarkoil, Ayinkudi, Karambakudi, Mimisal, Malaiyur and Mandapam 5 each, Valangaiman, Kodiayakarai, Echanviduthi, Muthupet, Thanjai Papanasam, R.s.mangalam and Tirumayam 4 each, Kumbakonam, Sivaganga, Tarangambadi, Paramakudi, Mayiladuthurai, Adanakkotai, Thiruvidaimaruthur, Gandarvakottai, Tirupathur, Tiruvaiyaru, Thanjavur PTO, Budalur, Illayangudi, Perungalur, Pudukottai, Lower Anaicut and Ramanathapuram 3 each
4 Feb	Velankanni 10, Tirupoondi and Ponnamaravathi 6 each, Alapuzha, Mayiladuthurai, Mannargudi and Vettikadu 4 each, Pudukottai, Thanjavur, Manjalaru, Orthanad, Tirumayam, Karambakudi, Keeranur, Manalmedu, Karaiyur, Gandarvakottai, Adanakkotai, Annavasal, Thalaignayer, Sirkali and Needamangalam 3 each
5 Feb	Nil
6 Feb	Gulmarg R.s. 4
7 Feb	Namsai 4, Koloriang and Basar 3 each
8 Feb	Bhalukpong 6, Jia Bharali NT Xing 5, Majuli 4, Sankalan, Itanagar and Sibsagar 3 each
9 Feb	Nil
10 Feb	5-Banihal;4-GulmargR.s.,Manali,Kishtwar,Kupwara,Pahalgam,PTOKoksarandTissa; 3 - Batote, Srinagar IAF, Bhaderwah ARG, Rambagh AWS, PTO Gondla, Kothi,Ganderbal,ShalimarAgro,Srinagar,RMBaghARG,GovindpuraAWS,RajPuraARG, Konibal,QaziGund,KargilandBadarwah.
11 Feb	Nancowry 5, Kothi 3
12 Feb	Nil
13 Feb	7-Yingkiong;6-Tuting;3-KabuBasti,JonaiARG,KoloriangandDaparijo.
14 Feb	Nil
15 Feb	Nil
16 Feb	Nil
17 Feb	Nil
18 Feb	Long Island 3
19 Feb	Nil
20 Feb	Nil
21 Feb	Nil
22 Feb	Kibithu 6, Koloriang 4, Nadaun, Mashobra AWS, Tezu, Tuting, Daparijo, KabuBasti, Jonai ARG, Dholla Bazar and Jiagaon 3 each
23 Feb	7-Tamulpur;6-NeoraandUdalguriAWS;5-Tuting,TanglaARG,TezuandPasighatAP;4 - Nagarkata and Kibithu; 3 - Khowang, Khliehriat, Badatighat, Gangtok, RanganadiNtXing, Bihubar, Dholla Bazar, Moranhat, Nahar Katia, Dhemaji, D/Mohanbari AP, KajolgaonAWS,BijniARG,Chengmari/Diana,KabuBasti,ManashNhXing,Yingkiong,DeomaliAWS, Roing,NamsaiandJiagaon.
24 Feb	Singhik and Margherita 5 each, Mangan, Deomali and Yingkiong 4 each, Chungthang, Shipgyar, Kibithu and Udaipur 3 each
25 Feb	Umrangso 3
26 Feb	Mangan and Singhik 5 each, Chungthang 4, Shipgyar 3
27 Feb	Nil
28 Feb	Singhik 3

region of Northwest India which was excess at 129% of L.P.A. The rainfall over homogeneous region of East & Northeast India (11% of L.P.A.) was fourth lowest since 1901, with all the sub-divisions recording *large deficient* or *no rainfall*. Previous lowest rainfall years were 1946, 2010, 2006 and 1923. The monthly rainfall over the homogenous regions of Central India and South Peninsular India was 25% and 34% of L.P.A, respectively. In this month, 64% of the area of the country (25 sub-divisions) experienced *deficient / large deficient / no rainfall*. Out of the 36 meteorological sub-divisions of India, the month's rainfall was *large excess* in 5, *excess* in 1, *normal* and *deficient* in 5 each, 17 *large deficient* and 3 sub-divisions received *no rainfall*.

3.1.4. *Temperature*

The maximum temperatures were generally below normal over the Northwest part of the country and adjoining Central India. The minimum temperatures were *above normal* over the eastern parts of central India. The season's lowest minimum temperature over the plains of the country was -2.7°C at Churu (west Rajasthan) on 17th January 2023.

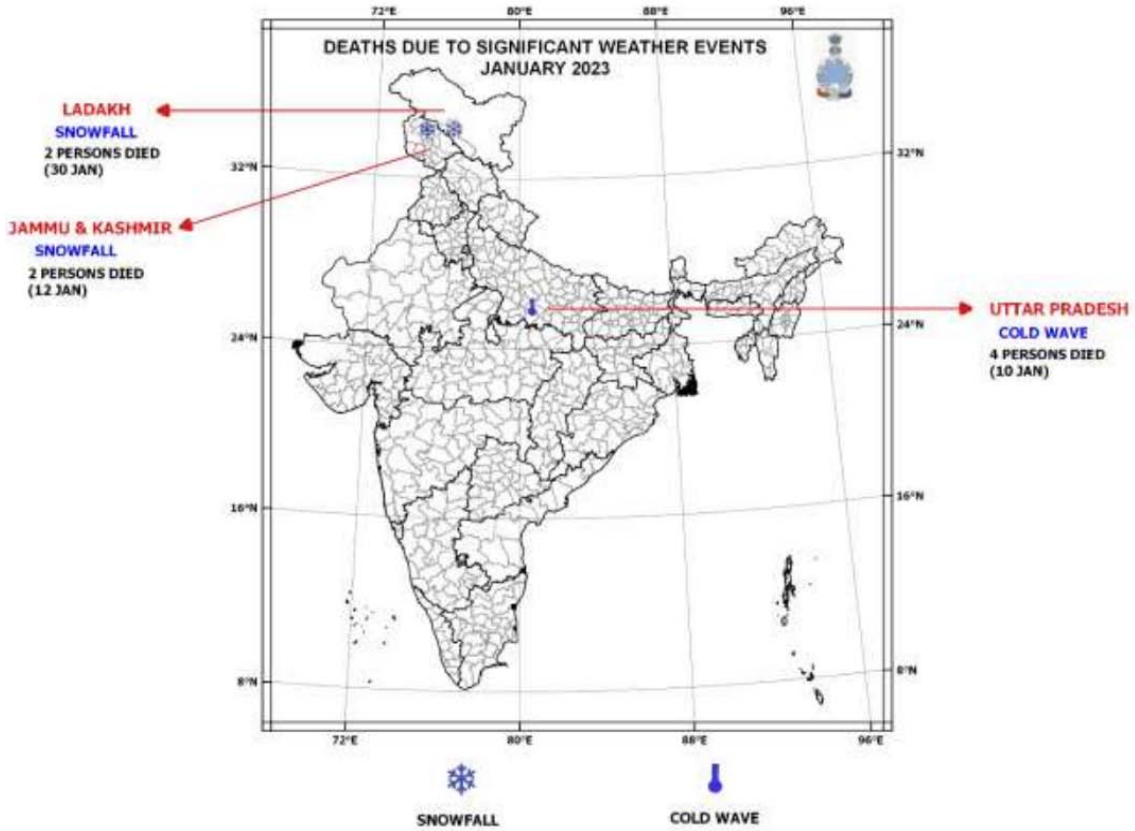
Severe cold wave / cold wave conditions were observed from the first week of the year especially over Rajasthan, Punjab and Haryana. They spread over North India over sub divisions, *viz*., Uttarakhand, Uttar Pradesh and Madhya Pradesh. In an uncommon event cold wave was observed over north interior Karnataka between 12th - 14th January.

3.1.5. *Damages associated with Disastrous weather events*

During January 2023, total 8 persons reportedly claimed to be dead and one person went missing. The details of causalities given below, which are based on real time media reports. The figure below shows deaths due to significant weather events during January 2023. (Based on real time media reports).

SNOWFALL : Total 4 persons reportedly claimed to be dead and one person went missing, during 1st January to 31st January.

COLD WAVE : 4 persons reportedly claimed to be dead due to cold wave in Fatehpur district of Uttar Pradesh on 10th January.



Source : IMD, Climate Summary for the month of January 2023

3.2. *February*

3.2.1. Storms *and Depressions*

Other than the Depression at the end of January which became less marked in February, no other intense system formed over the Indian seas during this month.

3.2.2. *Other synoptic features and associated weather*

As given in Table 3, 11 western disturbances (1 upper air cyclonic circulation, 6 troughs in westerlies and 4 induced cyclonic circulations), 4 upper air cyclonic circulations and 2 other troughs/wind discontinuities formed, which affected the weather over the country during the month of February.

Rainfall over the country during the month was less than normal over all the regions as well as the country. The monthly precipitation over all India (33% of L.P A.) was the sixth lowest since 1901. Prior to that the lowest rainfall years were 1960, 1902, 1918, 1955 and 1911. Rainfall over the homogeneous region of Central India (1% of L.P.A.) was lowest since 1901. During this month, out of the 36 meteorological sub-divisions, no sub-division recorded *large excess* rainfall, 1 sub- division of Tamil Nadu, Puducherry & Karaikal received *excess* precipitation, 3 *normal*, 1 *deficient*, 11 *large deficient* rainfall and *no rain* in 20 sub-divisions. Table 1 shows the sub-division wise rainfall statistics for February 2023.

3.2.4. *Temperature*

The maximum temperatures were more than *normal* over the country particularly over North and Central India, they were *appreciably above normal* over the sub-divisions of Jammu Kashmir & Ladakh and West Rajasthan and *markedly above normal* over Chhattisgarh sub- division. The minimum temperatures were generally above normal over Northwest and adjacent Central India and generally below normal over the homogenous region of South Peninsular India.

India recorded the hottest February ever; the monthly average maximum temperature and the mean temperature were the highest since 1901 and the average minimum temperature was the second highest from 1901. Significantly higher than normal maximum temperatures were experienced over Gujarat State and Konkan & Goa. This may be attributed to the absence of any active western disturbance in February, which led to dry spells over the plains and subdued rainfall/snowfall over hills. An anti-cyclone over south Gujarat which led to subsidence of air and hence, warming over Gujarat and advection of heat energy to northwest India. It also resulted in weaker sea breeze and stronger land breeze over Konkan coast leading to abnormally high temperatures over the sub division.

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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%
No Rain	: –100%
(*ii*) Intensity (during the 24 hours period ending at 0300 UTC)	
Very light	0.1 to 2.4 mm
Light	2.5 to 15.5 mm
Heavy rainfall	: 6.5 cm to 11.5 cm
Very heavy rainfall	: 11.6 cm to 20.4 cm
Extremely heavy rainfall	: 20.5 cm and above
Heavy snowfall	: 64.5 cm to 115.5 cm

(B) Temperatures

Cold Wave is considered when minimum temperature of a station is 10 °C or less for plains and 0 °C or less for Hilly regions

(a) *Based on Departure*

Cold wave	: Negative Departure from normal is 4.5 °C to 6.4 °C
Severe Cold Wave	: Negative Departure from normal is more than 6.4 °C
Based on Actual Minimum temperature (for plain stations only)	
Cold wave	: When minimum temperature is ≤ 04 °C
Severe Cold Wave	: When minimum temperature is ≤ 02 °C

(b) *Cold Day*

It should be considered when minimum temperature is 10 °C or less for plains and 0 °C or less for Hilly regions	
Cold wave	: Maximum temperature Departure is –4.5 °C to –6.4 °C
Severe Cold Wave	: Maximum temperature Departure is < –6.4 °C
Markedly below normal	: departure of minimum temperature from normal is from –5 °C or less
Appreciably below normal	: departure of minimum temperature from normal is from –3.1 °C to –5 °C
Below normal	: departure from normal is –1.6 °C to –3.0 °C
Normal	: departure from normal is –1.5 °C to +1.5 °C
Above Normal	: departure of minimum temperature from normal is +1.6 °C to 3.0 °C
Appreciably above normal	: departure of the minimum temperature from normal is from +3.1 °C to +5.0 °C
Markedly above normal	: departure of the minimum temperature from normal is +5 °C or more

(C) *Fog*

Dense Fog	: When the visibility is between 50-200 m
Very Dense Fog	: When the visibility is < 50 m