



Government of India
Earth System Science Organization Ministry
of Earth Sciences
India Meteorological Department

Dated: 7 Jan, 2020

Subject: Monthly Weather Review for the month of Dec, 2020 and Weather Outlook for the month of Jan 2021

1. Status of northeast monsoon rainfall over southeast Peninsular India during 1 Oct to 31 Dec 2020

The five meteorological subdivisions viz. Tamil Nadu, Coastal Andhra Pradesh, Rayalaseema, Kerala and south interior Karnataka of south Peninsula together receive about 30% of its annual rainfall during the Northeast (NE) monsoon season (October to December). Tamil Nadu in particular receives about 48% of its annual rainfall during this season. Fig 1 shows cumulative Northeast monsoon Rainfall (NEMR) over these five subdivisions as a whole during 1901-2020. It shows NEMR during Oct-Dec 2020 is excess with actual rainfall being 10.3% above the long period average of 33.76 cm. It is highest during last 5-years(2016-2020).

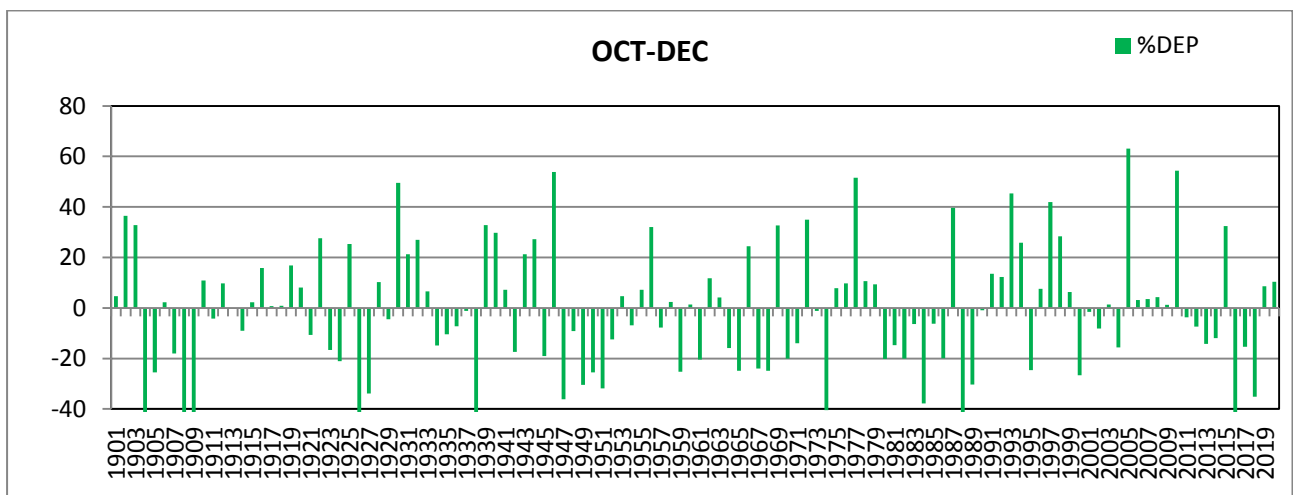


Fig 1: Time series of percentage departure from normal NEMR over South Peninsular India (Tamil Nadu, Coastal Andhra Pradesh, Rayalaseema, Kerala and south interior Karnataka) for the period of Oct-Dec during 1901-2020.

In the year 2020, the progress of NEMR over Tamil Nadu has been highly variable as it was subdued till 11 Nov with season's cumulative rainfall departure from normal during 1 Oct to 11 Nov as -46%. However, rainfall over Tamil Nadu and Puducherry and adjoining southeast Peninsula significantly enhanced during the 2nd fortnight of Nov 2020 and 1st week of Dec 2020 due to formation and movement two back by back Cyclones towards Tamil Nadu coasts during this period. The **Very Severe Cyclonic Storm 'NIVAR' in Bay of Bengal (21st to 27th November) moved across** north Tamil Nadu. The **Cyclonic Storm 'Burevi' (1st -3rd December 2020)** crossed Sri Lanka coast as a cyclonic storm on 2nd December 2020 emerged into Gulf of Mannar, then crossed south Tamil Nadu coast near Pamban on 03rd Dec. evening and then weakened into a Deep Depression and lay over Gulf of Mannar, close to the coast of Ramanathapuram District, in the same evening. Thereafter, it weakened into a depression over the same area and remained practically stationary for 36-hours till 5 Dec 2020. As a result, during the period of 1 Oct to 9 Dec 2020, the cumulative rainfall in terms of % departure from normal over Tamilnadu improved from -16% by 2 Dec to +9% by 9 Dec 2020. However, thereafter for remaining days of Dec 2020 i.e. 10-31 Dec, no major rainfall spell occurred over the peninsular region due to absence of any major weather system. The cumulative NEMR 2020 over Tamilnadu, since 1 Oct till 31 Dec was reduced to +6% (refer Fig 2).

2. Monthly Rainfall Scenario over the country (01 to 31 Dec, 2020)

Rainfall over the country as a whole for the month of Dec 2020 shows that it has recorded 17 mm which is 2% lower than its Long Period Average (LPA) of 17.4mm with south Peninsula having +53% above LPA. Details are given below:

Rainfall over India during Dec 2020

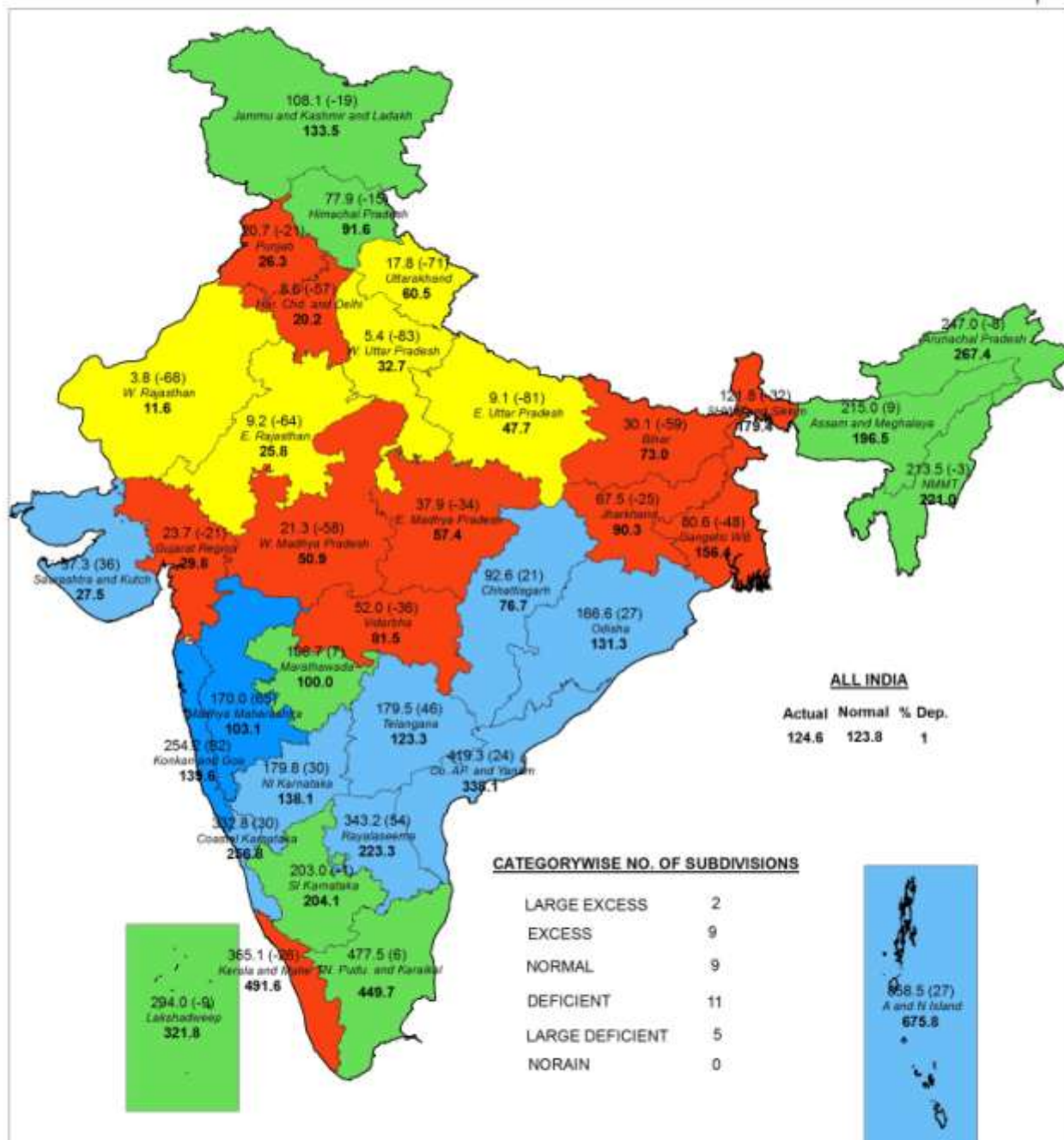
Regions	Actual Rainfall (mm)	Normal Rainfall (mm)	% Departure from LPA
Country as a whole	17	17.4	-2%
Northwest India	16	21	-24%
Central India	4.4	6.7	-34%
South Peninsula	51.2	33.4	53%
East & northeast India	3.2	13	-75%

During this month, 6 sub-divisions received large excess, 3 excess, 5 normal while remaining are deficient or large deficient rainfall (refer Fig 3). The rainfall has been mainly confined to southern parts of Peninsular India, Jammu & Kashmir, Ladakh, Gilgit-Baltistan & Muzaffarabad and parts of western India. The northern plains, central, eastern parts and northeast India received subdued rainfall during the month (**Refer Fig 2**).



SUBDIVISION RAINFALL MAP

Period : 01-10-2020 To 31-12-2020



Legend

Large Excess [80% or more] Excess [20% to 59%] Normal [-19% to 19%] Deficient [-59% to -20%] Large Deficient [-99% to -60%] No Rain [-100%] No Data

NOTES :

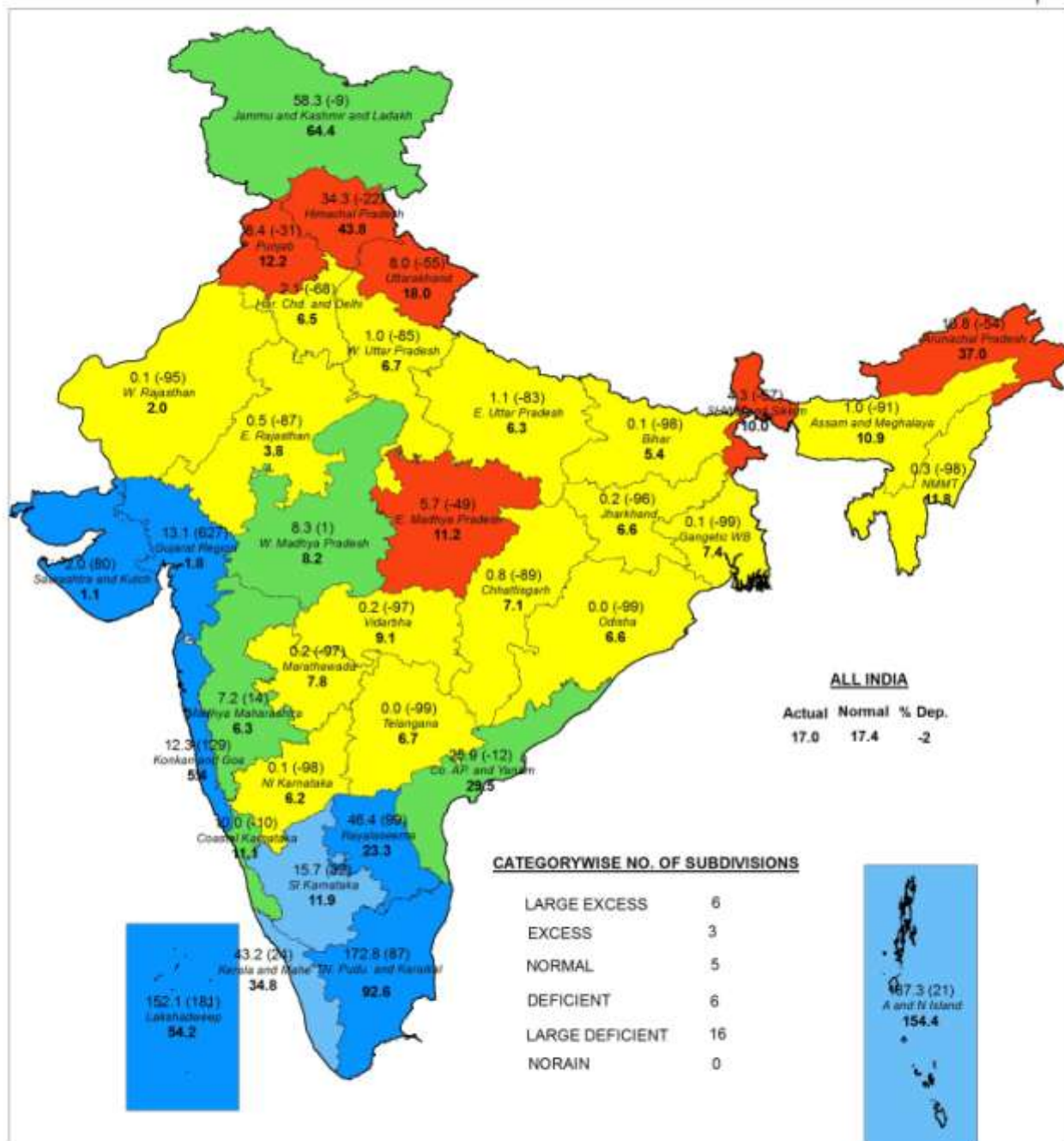
- a) RainFall figures are based on operation data.
- b) Small figures indicate actual rainfall (mm), while bold figures indicate Normal rainfall (mm).
- c) Percentage Departures of rainfall are shown in brackets.

Fig. 2. Meteorological subdivision-wise rainfall of post monsoon (1 Oct till 31 Dec 2020)



SUBDIVISION RAINFALL MAP

Period : 01-12-2020 To 31-12-2020



Legend

Large Excess [80% or more] Excess [20% to 59%] Normal [-19% to 19%] Deficient [-59% to -20%] Large Deficient [-99% to -60%] No Rain [-100%] No Data

NOTES :

- a) RainFall figures are based on operation data.
- b) Small figures indicate actual rainfall (mm), while bold figures indicate Normal rainfall (mm).
- c) Percentage Departures of rainfall are shown in brackets.

Fig. 3. Meteorological subdivision-wise rainfall during Dec, 2020

3. Frequency of Heavy Rainfall events

The occurrences of heavy rainfall events are shown in **Fig. 4**.

- **Heavy to very heavy rainfall with extremely heavy falls at isolated places** occurred over Tamil Nadu, Puducherry & Karaikkal on one day during the month.
- **Heavy to very heavy rainfall at isolated places** occurred over Tamil Nadu, Puducherry & Karaikkal on five days during the month.
- **Heavy rainfall at isolated places** occurred over Tamil Nadu, Puducherry & Karaikkal and Rayalaseema on three days each; over Coastal Andhra Pradesh & Yanam and Lakshadweep on two days each; over Kerala & Mahe and Andaman & Nicobar islands on one day each during the month.

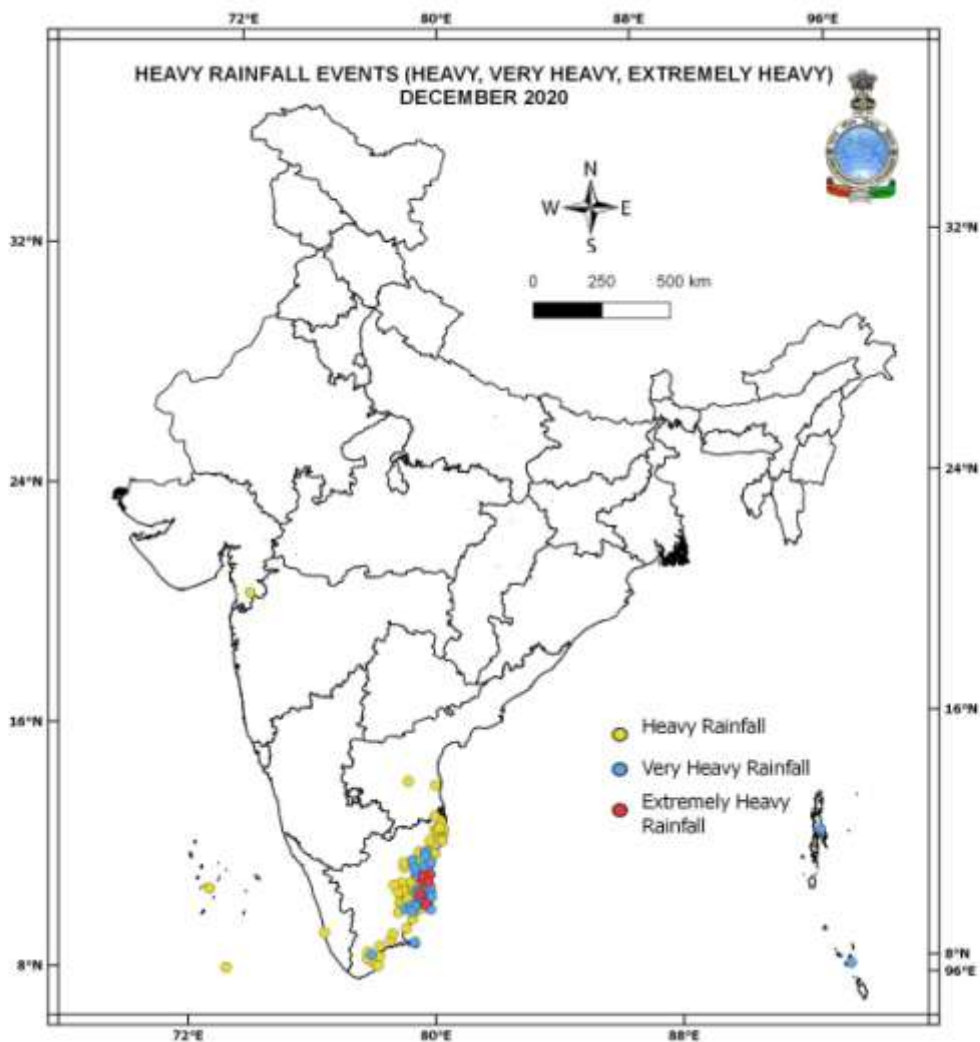


Fig. 4. Locations reported Heavy rainfall events during Dec, 2020

- **Heavy / Very Heavy Rainfall Warning Skill:**

No. of Heavy/Very Heavy Rainfall Events (>64.4 mm) and Warning Skill (correctness in %) during the month is given below:

warning issued for	No. of Heavy/Very Heavy Rainfall Events (>64.4 mm): 23
	Percentage correct (in %) for Rainfall >64.4mm
Day1 / 24 Hours	97%
Day2 / 48 Hours	97%
Day3 / 72 Hours	97%

4. Cyclogenesis over North Indian Ocean

The cyclonic storm, 'Burevi' originated from a low pressure area that developed over South Andaman Sea and adjoining areas on 28th November 2020. It concentrated into a depression in the early morning of 30th November over Southeast Bay of Bengal. It intensified into the cyclonic storm 'Burevi' over southwest BoB in the evening of 01st December 2020. It crossed Sri Lanka coast close to north of Trincomalee during midnight of 2nd December 2020 as a cyclonic storm. Moving across northern parts of Sri Lanka, it emerged into Gulf of Mannar in the morning and lay centred close to Pamban around noon of 03rd December. It crossed Pamban area in the evening of 3rd December. Remaining stationary over Gulf of Mannar close to Ramanathapuram for 36 hours, it gradually weakened into a well marked low pressure area around noon of 05th December.

Genesis of "Burevi" was predicted in the extended range outlook issued on 26th November (about 4 days in advance of formation of depression over southeast BoB on 30th November). The landfall point forecast errors in case of landfall over Sri Lanka for 12, 24, 48 and 60 hrs lead period were 20, 25, 35 and 44 km respectively against the LPA errors (2015-19) of 25, 45, 69 and 99 km during 2015-19 respectively. The landfall point forecast errors in case of landfall over Pamban area for 12, 24 and 48 hrs lead period were 0, 0 and 150 km respectively against the LPA errors (2015-19) of 25, 45 and 69 km during 2015-19 respectively. The track forecast errors for 24, 48 and 72 hrs lead period were 55.3, 61.6, and 131.2 km respectively against the LPA errors (2015-19) of 80.6, 125.5, and 171.2 km respectively. The absolute error (AE) of intensity (wind) forecast for 24, 48 and 72 hrs lead period were 4.2, 4.7 and 9.3 knots against the LPA errors of 8.9, 13.0, and 15.4 knots during 2015-19 respectively.

The observed and forecast track based on 0600 UTC of 2nd December about 24 hrs prior to landfall over Pamban area demonstrating accuracy in track and landfall prediction is presented in Fig. 5.

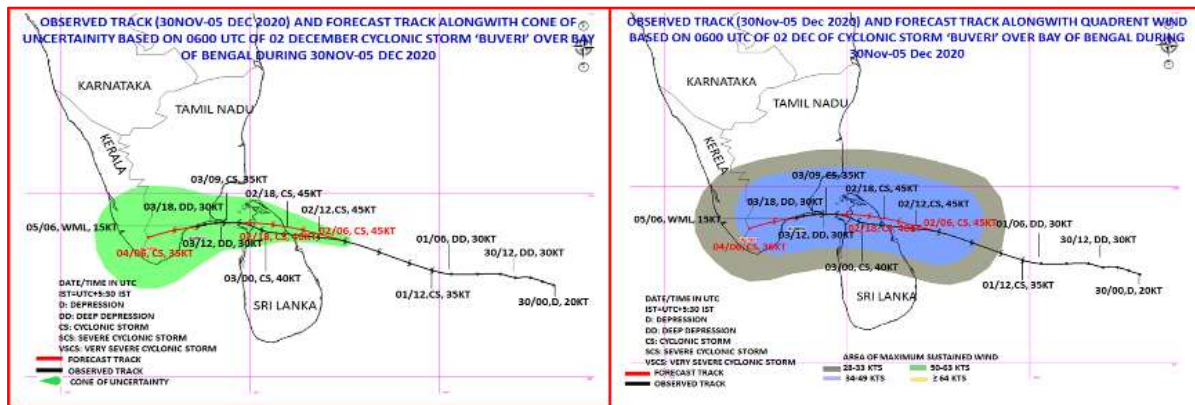


Fig.5: The observed and forecast track of cyclonic storm “BUREVI” based on 0600 UTC of 2nd December demonstrating accuracy in landfall, track and intensity prediction (about 24 hrs prior to landfall over Pamban Area)

Thus, the track, intensity and landfall of all the cyclonic storms during 2020 were predicted accurately with sufficient lead time by India Meteorological Department leading to significant decrease in loss of lives.

5. Characteristics of Temperatures, Cold Wave, Cold Days and Dense Fog conditions during Dec 2020

5. 1. Monthly Average Temperature features over the country and the northwest India

Fig 6 shows time series of all India monthly average maximum, average minimum and mean temperature during 1971-2020 for the month of Dec. The actual observed average maximum, average minimum and average temperature for the country as a whole during Dec 2020 are 26.6° C, 15.1 ° C and 20.9° C against normal of 26.6° C, 14.4 ° C and 20.5° C respectively. It shows respective temperatures were near to normal (i.e. close to normal, 0.7° C above normal and 0.4 above normal respectively). Fig 7 shows time series of Northwest India monthly average maximum, average minimum and mean temperature during 1971-2020. The average maximum, average minimum and mean temperature over Northwest India as a whole during Dec 2020 was 20.4 ° C, 7.0 ° C and 13.7 ° C respectively. The mean and maximum temperatures were below normal (13.8 ° C, 20.7 ° C) by about -0.03 ° C and -0.27 ° C respectively while minimum temperature was close to normal.

Fig 8 shows observed spatial temperature pattern of monthly average maximum, average minimum and average temperature over India and their departure from normal for the month of Dec 2020. Though, all India and regional temperature averages have not shown much anomalies(refer Fig 6), spatial temperature pattern over India shows maximum temperatures were below normal by 1-3 ° C in Dec across Indo-Gangetic plain and Jammu and Kashmiri and above normal over eastern parts of central India while minimum temperatures were below normal by 1-2 ° C in Dec 2020, over Uttar Pradesh, Haryana and Delhi.

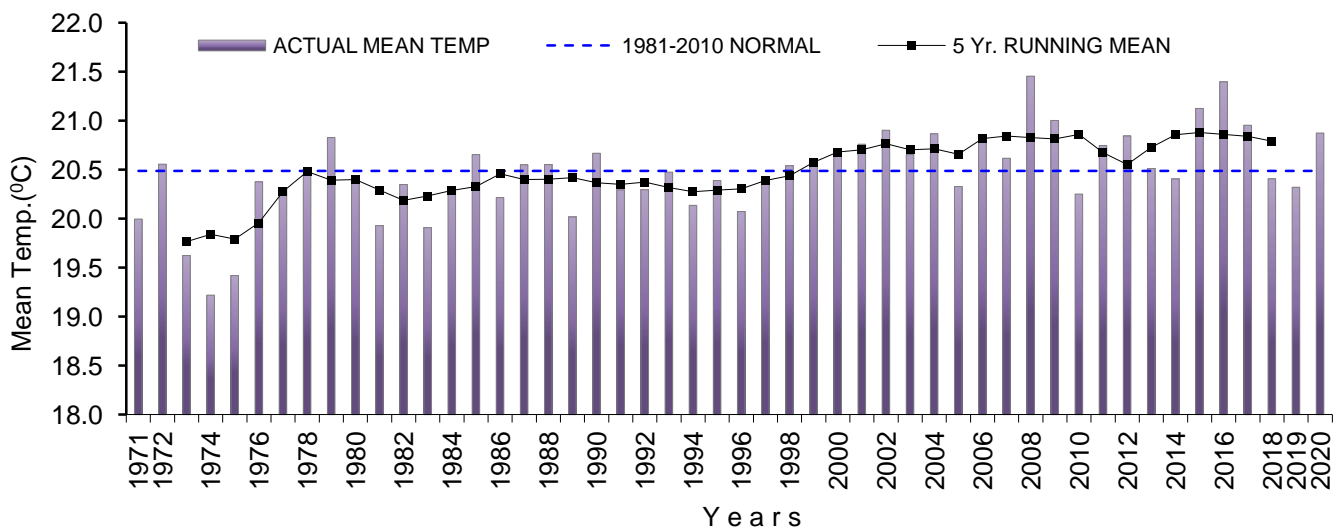
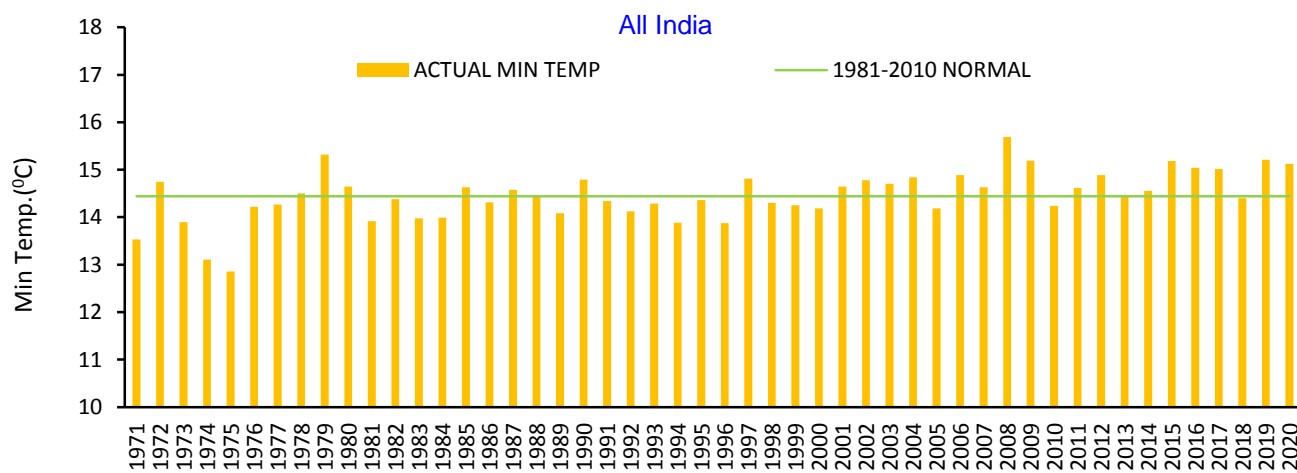
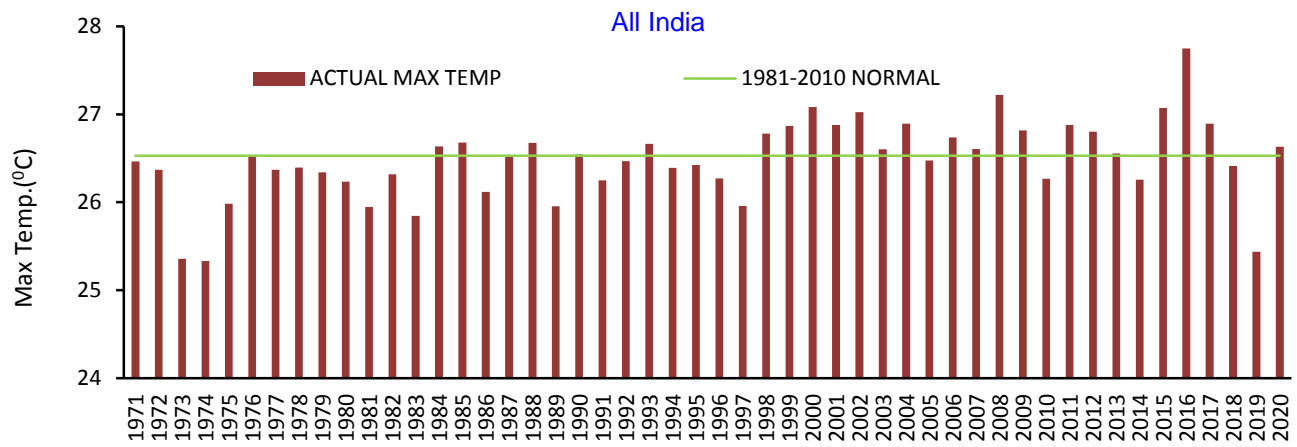


Fig 6: Time series of All India monthly average maximum, average minimum, mean temperature for the month of Dec during 1971-2020

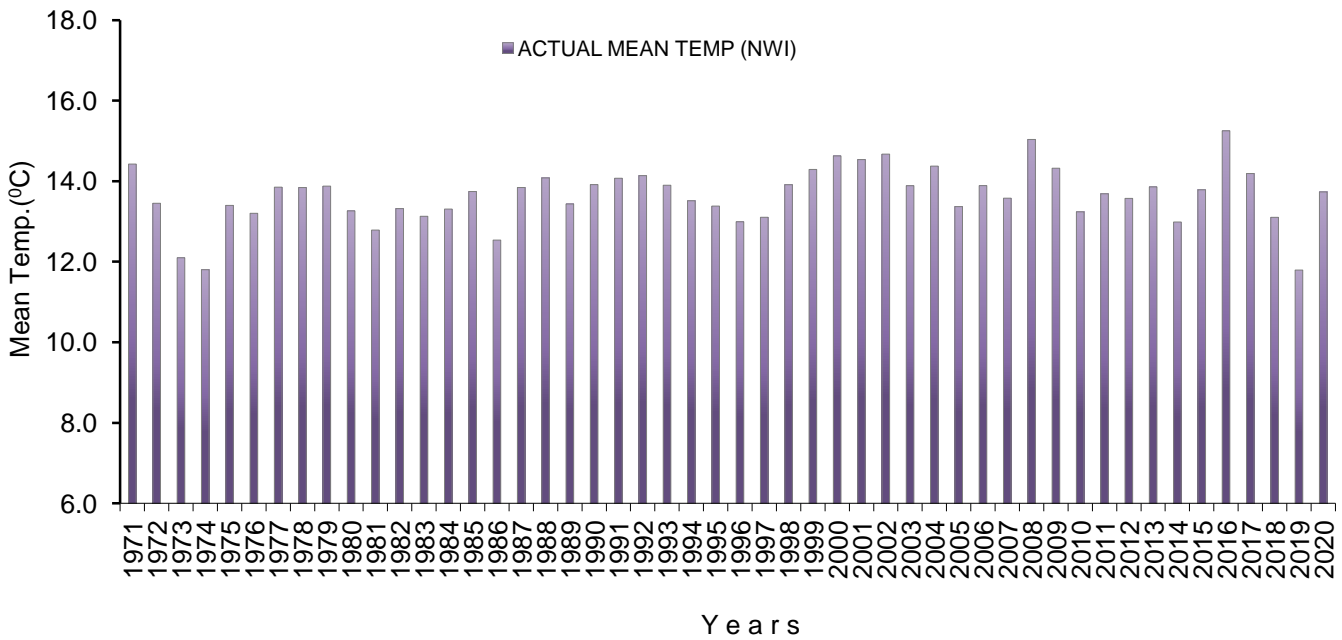
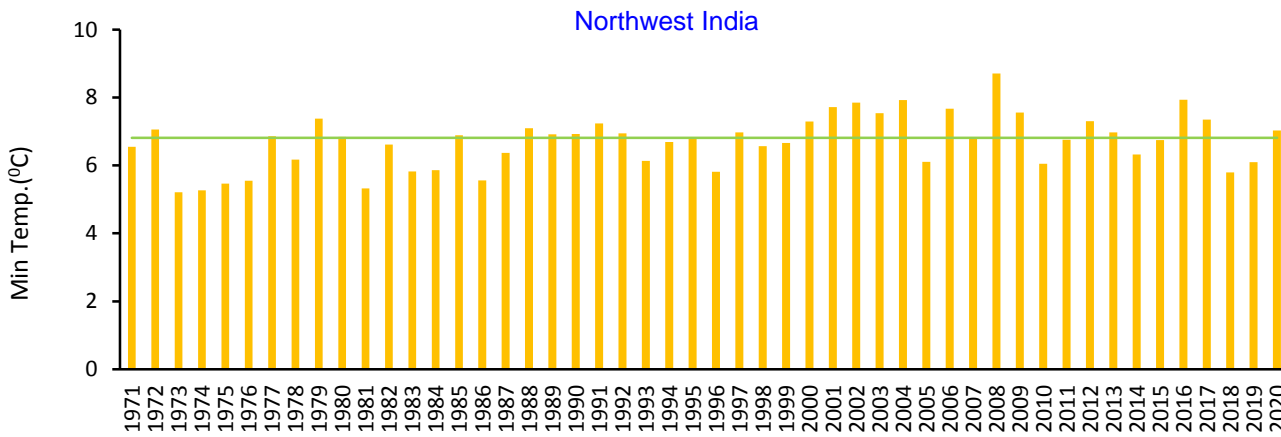
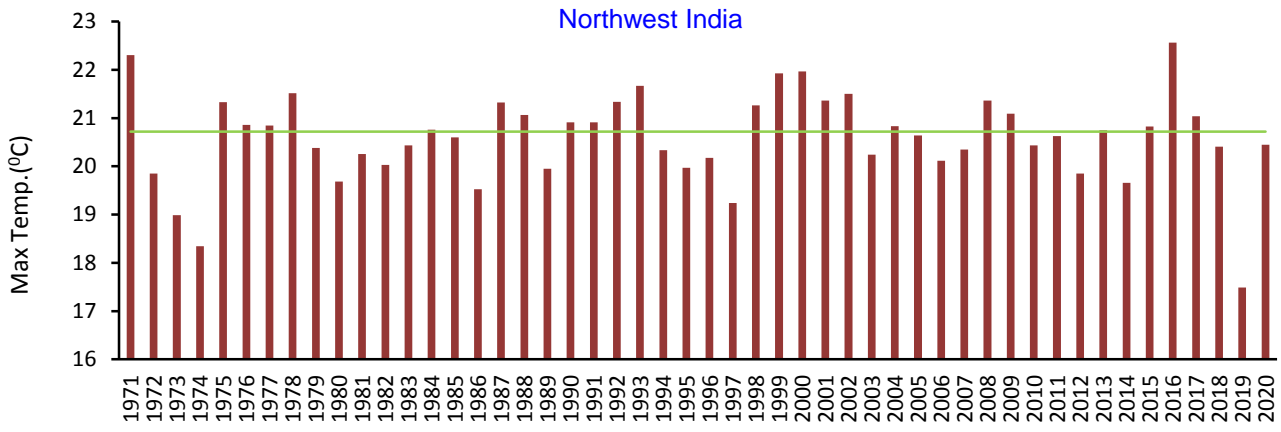


Fig 7: Time series of Northwest India monthly average maximum, average minimum, mean temperature for the month of Dec during 1971-2020

and above normal over central and western India.

TEMPERATURE FOR THE MONTH DEC 2020 & ITS ANOMALY

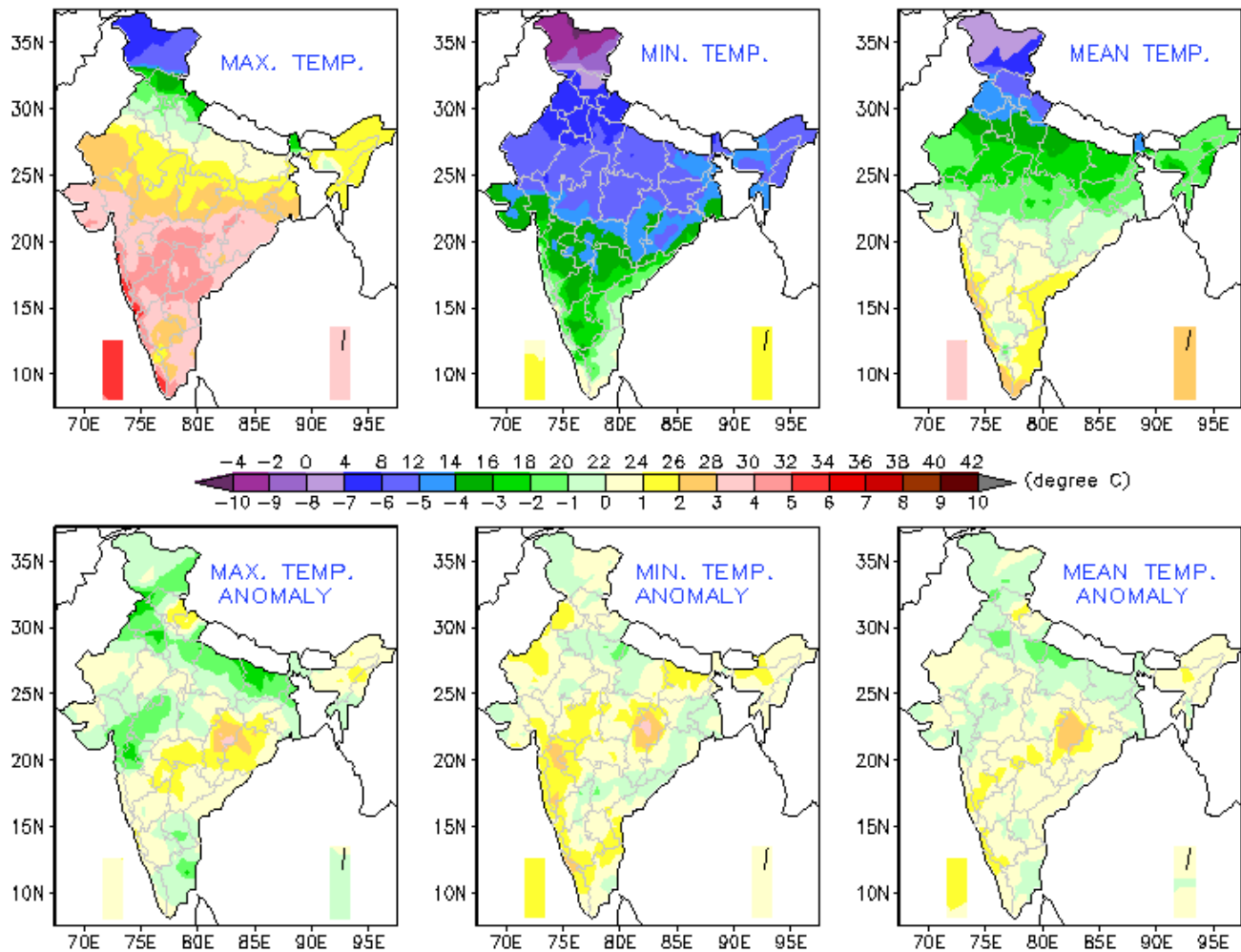


Fig 8: Observed spatial pattern of monthly average maximum, average minimum, and mean temperatures over India (top three from left to right) and their departure from normal for Dec 2020(lower three from left to right).

5.2 Observed sub-divisional average temperature anomalies for December 2020

Fig 9 (a, b) shows Met Sub-division averaged Observed maximum and minimum temperature anomalies for the month of December 2020. The observed maximum temperature anomalies were positive and $\geq 0.5^{\circ}\text{C}$ over some part of the northwest and most parts of west coast, east central, adjoining east and northeast India. The observed maximum temperature anomalies were $\geq 1^{\circ}\text{C}$ over west Rajasthan, Saurashtra and Kutch, Konkan and Goa, coastal Karnataka, Chhattisgarh, Orissa, Gangetic West Bengal, Sub Himalayan West Bengal, Arunachal Pradesh and NMMT. The maximum temperatures anomalies were negative over north, north along the plains of Himalayas and most parts of south peninsular India. It was $\leq 1^{\circ}\text{C}$ over Jammu and Kashmir and Rayalaseema.

The observed minimum temperature anomalies were positive over most part of the country except over extreme north India where anomalies were negative. The minimum temperature anomaly was $\leq 1^\circ\text{C}$ over Jammu and Kashmir. The observed minimum temperature anomalies were $\geq 0.5^\circ\text{C}$ over most parts of northwest, central, west coast, south peninsular India, northeast and few subdivisions of east India. The subdivisions of Gujarat, Madhya Maharashtra, Konkan and Goa, coastal Karnataka, Kerala, Sub Himalayan West Bengal (SHWB), NMMT experienced minimum temperature anomalies $\geq 1^\circ\text{C}$.

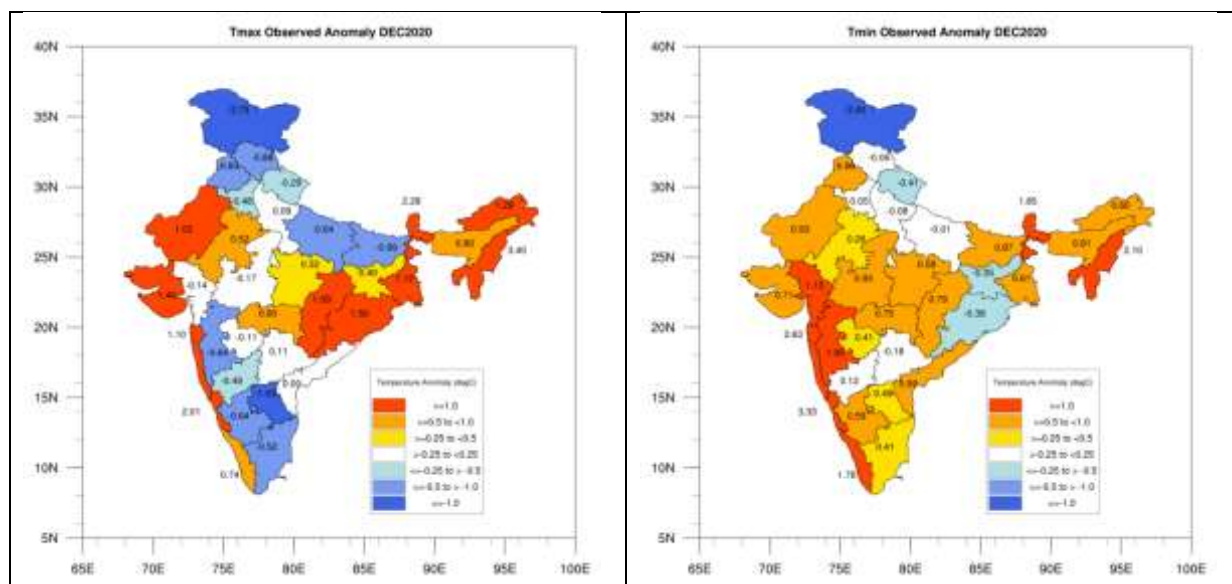


Fig 9 (a, b) Met Sub-division Observed maximum and minimum temperature anomalies for the month of December 2020.

5.3. Cold Wave and Cold Day conditions

◆ **Cold wave conditions at a few places with severe cold wave conditions at isolated places** occurred over Haryana, Chandigarh & Delhi during 16-20, 23-24 and 28-31 Dec. **Cold wave conditions at isolated places** occurred over Uttar Pradesh during 17-20, 23-24 and 30-31 Dec ; over Gangetic West Bengal, Chhattisgarh and Odisha during 20-24 Dec, over Bihar during 20 and 21 Dec and over north Madhya Pradesh during 23-24 and 29-31 Dec. **Table shows Date wise daily lowest minimum temperature value as recorded among all reported stations over the plains of the country for the month of Dec 2020.**

◆ **Cold day conditions at many places with severe cold day conditions at isolated places** occurred over Haryana, Chandigarh & Delhi and west Uttar Pradesh during 15-18 and 29-31 Dec and over East Uttar Pradesh during 19-22 Dec. The cold day conditions at isolated places occurred over Bihar during 19-23 Dec; over north Madhya Pradesh during 19-20 and 29-31 Dec.

5.3 Dense fog conditions

- Dense fog occurrences over central and eastern parts of Indo Gangetic Plains (IGP) region was sub-dense during Dec 2020 while at its extreme western parts, i.e. over Punjab areas it was higher and more frequently observed. Large-scale dense fog coverage across whole IGP plains was hardly

observed on any single day in Dec 2020, due to unfavorable large-scale features and absence of persistent subsidence pattern along the whole plains at any date.

- Daily data shows, Dense to very dense fog occurred at a few places to most places over Punjab during 16-31 Dec and at isolated places during 13-15 Dec; at isolated to few places over Haryana, Chandigarh & Delhi on 13, 16, 22, 24, 25, 30 and 31 Dec; at isolated places over Uttar Pradesh during 16-18 Dec and at a few places to many places over east Uttar Pradesh during 19-25 Dec; over Bihar, Gangetic West Bengal, northeastern states during 6-11 Dec 2020.

6. Large scale features in Dec 2020 and forecast

- Currently, La Niña conditions are prevailing over equatorial Pacific and Sea Surface Temperatures (SSTs) are below normal over central and eastern equatorial Pacific Ocean. The latest weekly SST departures are: Niño 4 -1.1°C Niño 3.4 -1.2°C Niño 3 -0.9°C Niño 1+2 -1.3°C. The latest Monsoon Mission Climate Forecasting System (MMCFS) forecast indicates that colder than normal SST anomaly is most likely to persist over the Niño 3.4 region and La Niña conditions likely to sustain at least early part of the next year.
- At present, neutral Indian Ocean Dipole (IOD) conditions are observed over Indian Ocean and the latest MMCFS forecast indicates neutral IOD conditions are likely to continue during the coming months.
- The Madden Julian Oscillation (MJO) index is currently in Phase 3 with amplitude greater than 1. It is likely to remain in Phase 3 retaining the amplitude, with slow eastward propagation during Week 1 & in the first half of Week 2 and enter into Phase 4 with gradual reduction in amplitude during the second half of Week 2.

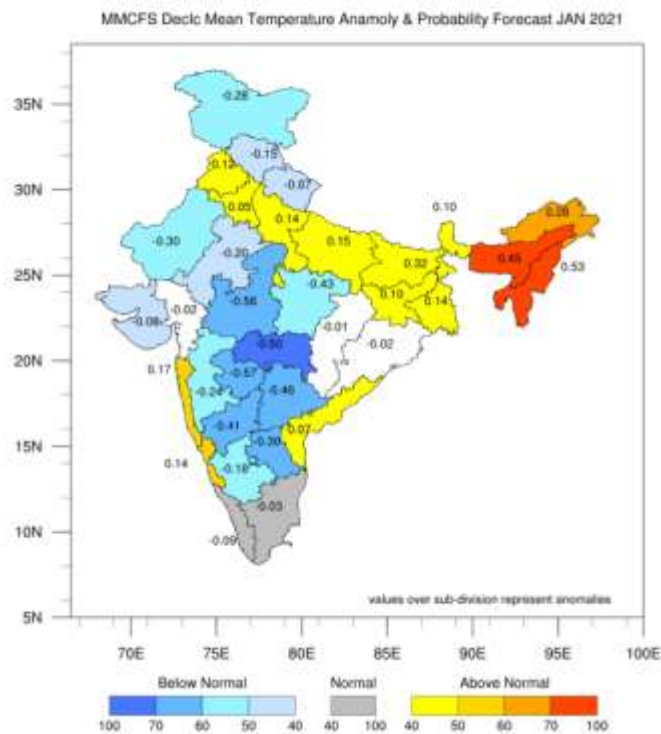
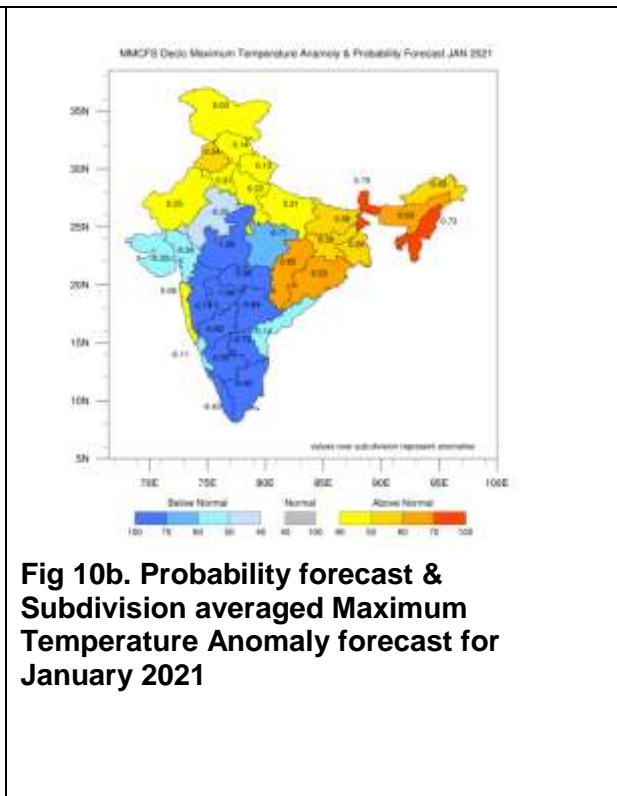
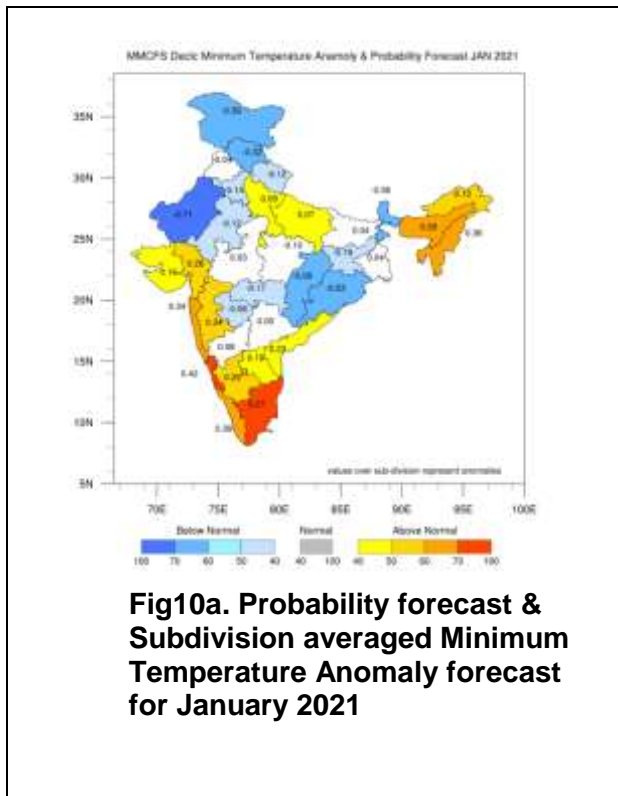
Table 1: Date wise Lowest minimum temperature as recorded amongst all reported stations in the plains of the country during Dec 2020.

Date (mm/dd/yy)	Min. Temp(deg C)	Place
12/1/2020	5.5	Churu(W Raj)
12/2/2020	6.5	Sikar(E Raj)
12/3/2020	6.5	Churu(W Raj)
12/4/2020	6.6	Churk(E UP)
12/5/2020	6.5	Fatehgarh(E UP)
12/6/2020	7	Churk(E UP)
12/7/2020	6.7	Fatehgarh(E UP)
12/8/2020	7.7	Hissar(Har)
12/9/2020	7.6	Furastganj (E UP)
12/10/2020	6.8	Panchmarhi (W MP)
12/11/2020	6.6	Panchmarhi (W MP)
12/12/2020	8.4	Bhiwani(Har) & Ganganagar (W Raj)
12/13/2020	6.7	Bhiwani(Har)
12/14/2020	4.5	Sikar(E Raj)
12/15/2020	3	Hissar(Har)
12/16/2020	2	Amritsar (Pun)
12/17/2020	0.5	Sikar(E Raj)
12/18/2020	-0.3	Churu(W Raj)
12/19/2020	-0.1	Churu(W Raj)
12/20/2020	1	Amritsar (Pun)
12/21/2020	3.3	Ambala (Har)
12/22/2020	3.3	Panchmarhi (W MP)
12/23/2020	2.7	Hissar(Har)
12/24/2020	2.1	Ludhiana (Pun)
12/25/2020	0.1	Pantnagar (Utt)
12/26/2020	2	Hissar(Har)
12/27/2020	2.6	Churk(E UP)
12/28/2020	0.6	Churu(W Raj)
12/29/2020	-0.4	Churu(W Raj)
12/30/2020	-1.5	Churu(W Raj)
12/31/2020	-1.3	Churu(W Raj)

7. Weather Outlook for Jan 2021

7.1 Temperature outlook

Fig 10a, 10b and 10c shows predicted sub-divisional probability and the subdivision averaged minimum, maximum and mean temperature anomalies (departures from the long term normal) respectively for the month of January 2021.



The probability forecast for minimum temperature (Fig.10a) indicates that below normal minimum temperatures are likely over West Rajasthan, East Rajasthan, Himachal Pradesh, Jammu & Kashmir, Haryana Chandigarh & Delhi (HCD), Sub Himalayan West Bengal & Sikkim

(SHWB), Jharkhand, Chhattisgarh, Odisha, Marathwada and Vidharbha. Subdivisions of Punjab, East and West Madhya Pradesh, Bihar, Gangetic West Bengal (GWB), Telangana and North Interior Karnataka (NIK) are likely to experience climatological probability for minimum temperature. Remaining subdivisions of the country is likely to experience above normal minimum temperatures. The probability forecast for maximum temperature (Fig.10b) indicates that all the subdivisions of southern peninsular India and most of the subdivisions of central India (West and East Madhya Pradesh, Vidharbha, Marathwada and Madhya Maharashtra) and few subdivisions of western India (Gujarat region and Sourashtra & Kutch) are likely to experience below normal Maximum temperature. Remaining subdivisions of the country are likely to experience above normal maximum temperatures.

The probability forecast for mean temperature (Fig.10c) indicates that most of subdivisions of India likely to experience below normal mean temperatures. However, above normal mean temperatures are likely to experience over Konkan and Goa, Coastal Karnataka, Costal Andhra Pradesh, most of the subdivisions along the foothills of Himalayas and Northeast India. Normal mean temperatures are likely to experience over Kerala and Tamilnadu

7.2. Rainfall Forecast

Rainfall for week 1: (07 to 13 January, 2021)

- Under the influence of a Western Disturbance as a cyclonic circulation over western parts of Afghanistan & neighbourhood in middle & upper tropospheric levels, Western Himalayan Region very likely to experience light isolated rain/snow and isolated rain over Punjab, Haryana, Northeast Rajasthan and West Uttar Pradesh on 08th January, 2021 and no weather is expected over northwest India during subsequent 5-6 days.
- Under the influence of cyclonic circulation over Southeast Arabian Sea and another cyclonic circulation over south Tamilnadu coast & neighbourhood in lower tropospheric levels, fairly widespread to widespread rainfall with isolated heavy falls and moderate thunderstorm, & lightning very likely over southern peninsular India during next 2-3 days.
- Under the influence of a trough in low level easterlies from Karnataka coast to Maharashtra coast in lower tropospheric levels; isolated to scattered rainfall with moderate thunderstorm & lightning at isolated places very likely over Maharashtra during next 2 days.
- Thereafter, under the influence of fresh spell of easterly wave, fairly widespread to widespread rainfall with isolated heavy falls very likely over Tamilnadu, Puducherry & Karaikal and Kerala & Mahe on 10th & 11th January, 2021.
- No significant rainfall likely over remaining parts of the country during the week.
- Cumulatively, above normal rainfall very likely over south peninsula & central India and below normal rain/snow likely over Western Himalayan Region during week 1 (Figs. 11 and 12).

Rainfall for week 2: (14 to 20 January, 2021)

- Due to the absence of any active Western Disturbance, below normal rain/snow also likely over Western Himalayan Region. Fresh easterly wave may cause normal to above normal rainfall over south India ((Figs. 11 and 12)..

Rainfall for week 3: (22 to 28 Jan 2021)

- Rainfall is very likely to be above normal over extreme southeast Peninsular India and below normal rainfall over western Himalayan region. Dry weather over rest parts of the country (Figs. 11 and 12).

7.3 Cyclogenesis over Indian region including North Indian Ocean: Week 1 and Week 2 Genesis Forecast (Till 21 Jan 2021)

The phase of MJO will support enhancement of convective activity over the Indian Ocean during weeks 1 & 2. Most of the numerical models including IMD GFS, GEFS, ECMWF, NCEP GFS, NEPS, and CGEPS (MME), NCUM & NEPS are not indicating any cyclogenesis during the forecast period. The Genesis Potential Parameter (GPP) based on IMD GFS indicates an un-organised potential zone over southwest Bay of Bengal off Sri Lanka coast & subsequently over Comorin area during latter half of the week 1. CGEPS (MME) indicates a less than 40 % probability for Cyclogenesis in the near equatorial belt and adjoining south Bay of Bengal (BoB) during the later part of week 1. IMD GFS alone is indicating formation of a Low pressure area over southwest BoB & adjoining Equatorial Indian Ocean during the initial half of week 2.

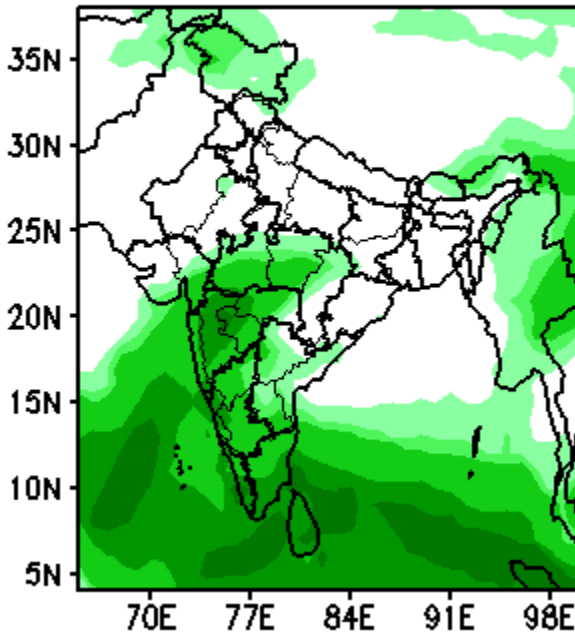
Considering all the above, it may be concluded that eastern half of the near equatorial convergence zone over the north Indian Ocean could remain active during the ensuing two weeks. However no cyclogenesis is predicted over the north Indian Ocean during next two weeks.

[.http://www.rsmcnewdelhi.imd.gov.in /images/bulletin/eroc.pdf\)](http://www.rsmcnewdelhi.imd.gov.in /images/bulletin/eroc.pdf)

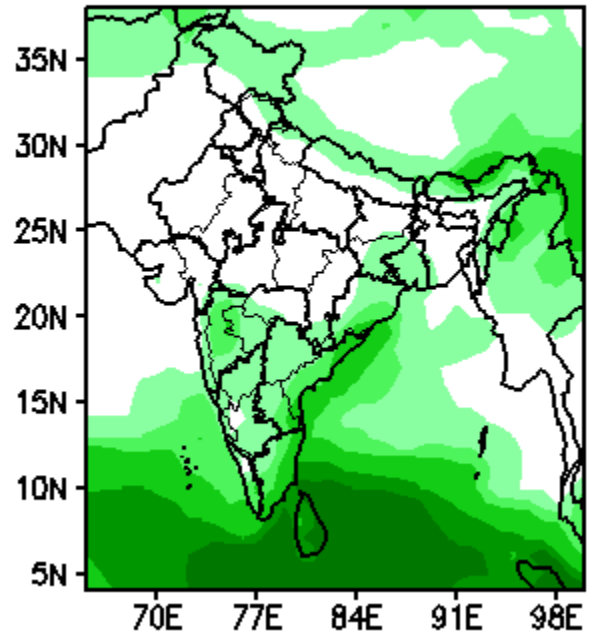
Next monthly update will be issued on first week of Feb, 2021

Forecast Rainfall (mm/day)

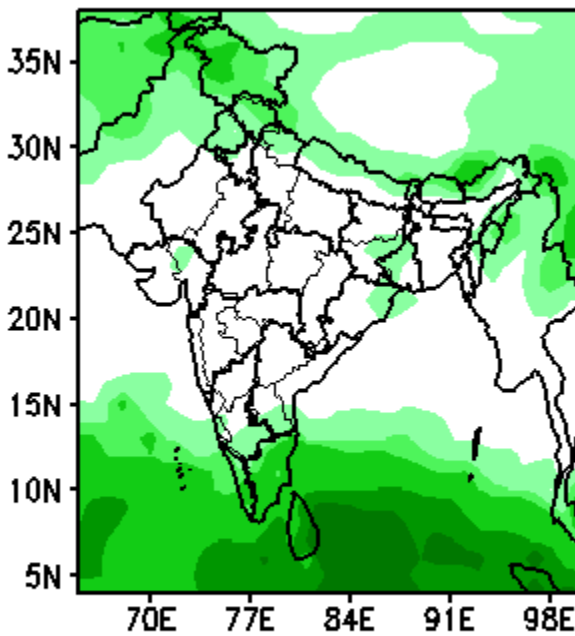
(Week1: 08Jan-14Jan)



(Week2: 15Jan-21Jan)



(Week3: 22Jan-28Jan)



(Week4: 29Jan-04Feb)

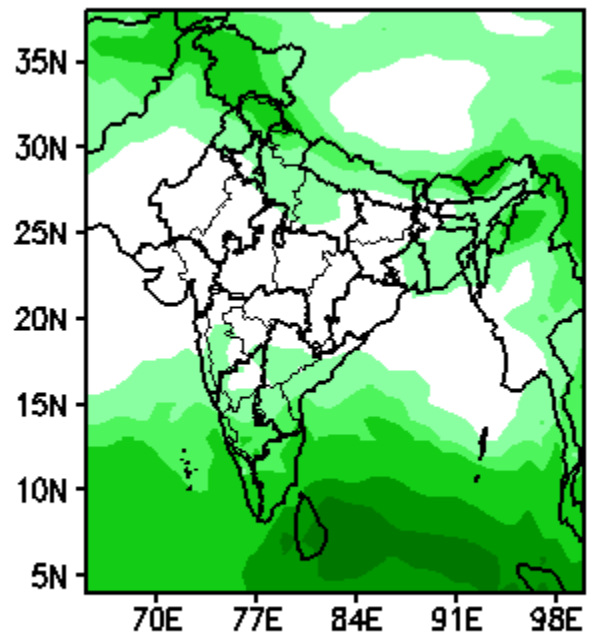
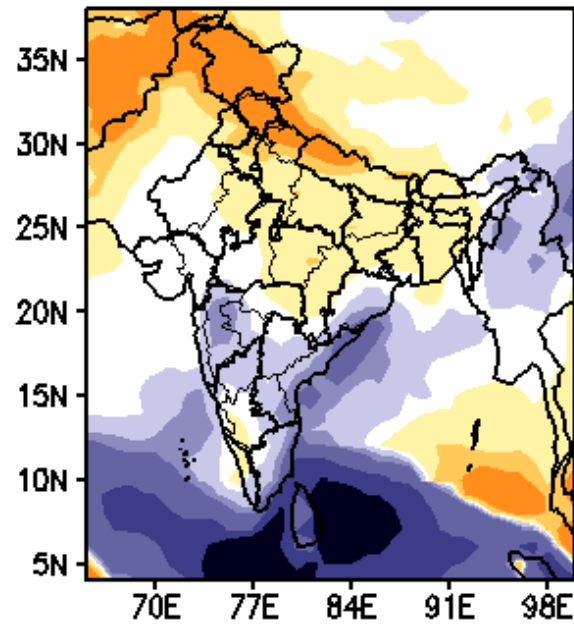
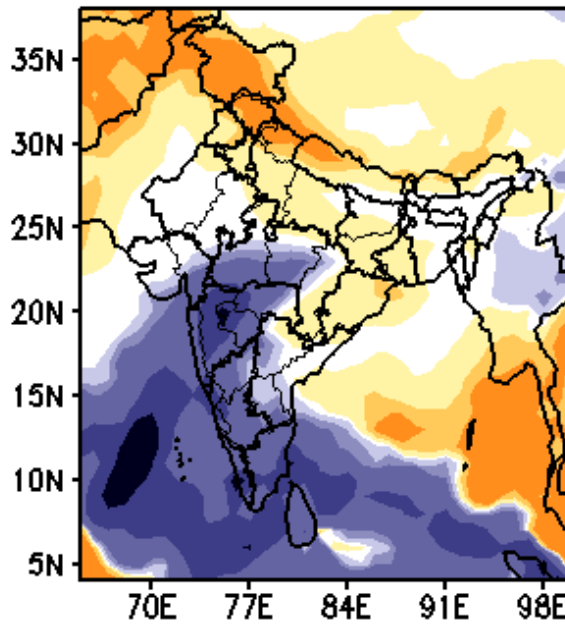


Fig 11: Rainfall forecast(Actual) in mm/day over the country for Dec(Week 1 to Week 4)

Forecast Rainfall Anomaly (mm/day)

(Week1: 08Jan–14Jan)

(Week2: 15Jan–21Jan)



(Week3: 22Jan–28Jan)

(Week4: 29Jan–04Feb)

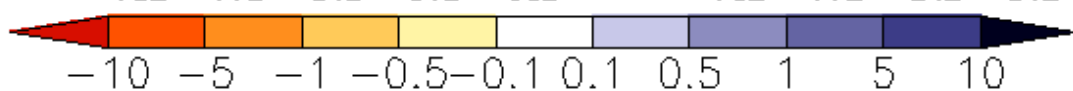
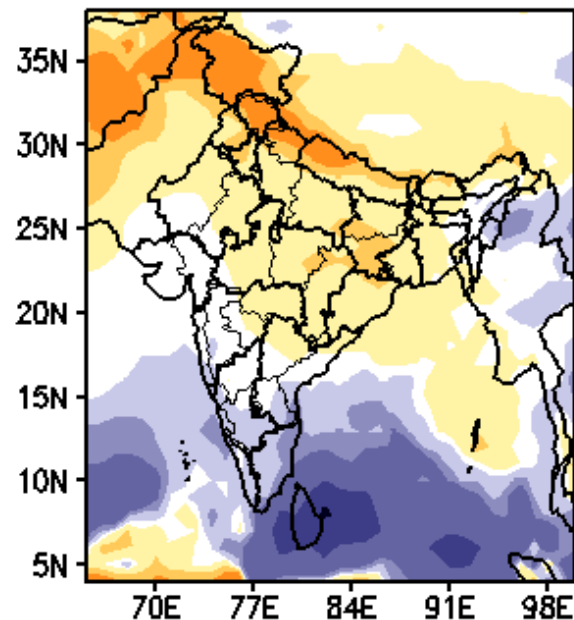
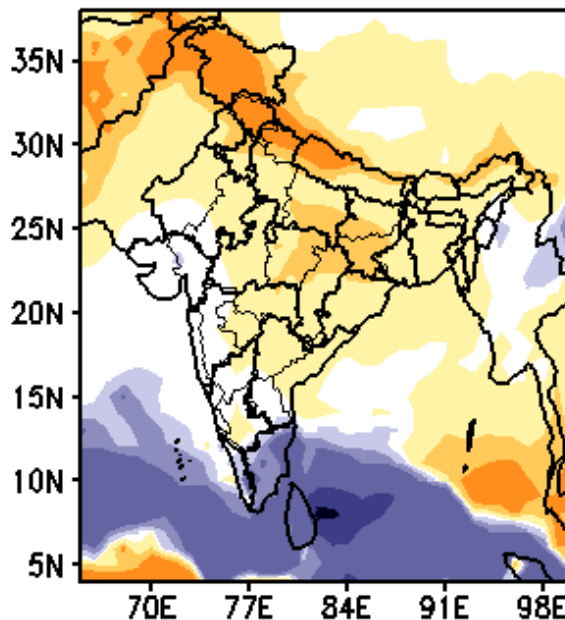


Fig 12: Rainfall forecast(in departure from normal) over the country for Dec(Week 1 to Week 4)