



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

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Subject: Weather Status for August, 2021 and Outlook for September, 2021

1. Salient features

- During August 2021, rainfall over the country as a whole was below Long Period Average (LPA) by -24%. It is also lowest August rainfall in last 12 years after 2009 (**Fig 1**).
- Two major spells of weak monsoon spells prevailed over the country i.e. 9-16 and 23-27 Aug, when Northwest, Central and adjoining Peninsular and West coast of India had subdued rainfall activities.
- Intra-seasonal variation in terms of week by week rainfall variation over India shows that monsoon rainfall activities were largely subdued consecutively for three weeks i.e. for week ending on 11 Aug, 18 Aug and 25 Aug 2021, when all India **Weekly cumulative rainfall** for the country as a whole were 35%, 36% and 21% below its Long Period Average (LPA) and the seasonal cumulative rainfall from 1st June became 2%, 6%, 9% and 10 % below the LPA.
- The formation of less number of low pressure systems(PLS) and their lesser number of days compared to the climatology and absence of their longer westward movements during the month of August 2021 contributed to the large deficient rainfall in central India as well as all India.
- Negative Indian Ocean Dipole over tropical Indian Ocean, unfavourable for Indian monsoon prevailed throughout the month of the Aug, which also contributed to deficient rainfall over India in the month
- Unfavorable Madden Julian Oscillation (MJO) conditions was observed and during most of the days, in the month of the Aug 2021, MJO was in the phase 8, 1 and 2 which were unfavorable for monsoon rainfall activity in the month over Indian region.
- Less West Pacific Typhoon activity was observed and so also absence of westward movement of their remnants into Bay of Bengal which again caused less formation of LPS over the Bay of Bengal.
- Most of the days monsoon trough was located north of its normal position which caused

subdued rainfall over Central Indian Region and normal to excess rainfall along the foothills covering Bihar, Assam, Meghalaya & Arunachal Pradesh.

- Southwesterly winds along west coast were weak and Off-shore trough along west coast was also present for few days in the month causing weak monsoon spells along west coasts many days in the month.

2. Rainfall characteristics

During August 2021, rainfall over the country as a whole was below Long Period Average (LPA) by -24%. So far during period 1901-2021, it is the 6th lowest after -32.5% in 1920, -28.4% in 2005, -26.5% in 2009, -25.6% in 1913 and -25.2% in both 1930 and 1993 (all are in % below LPA) in order from lowest values. It is also lowest August rainfall occurred in last 12 years after 2009. (Fig. 1).

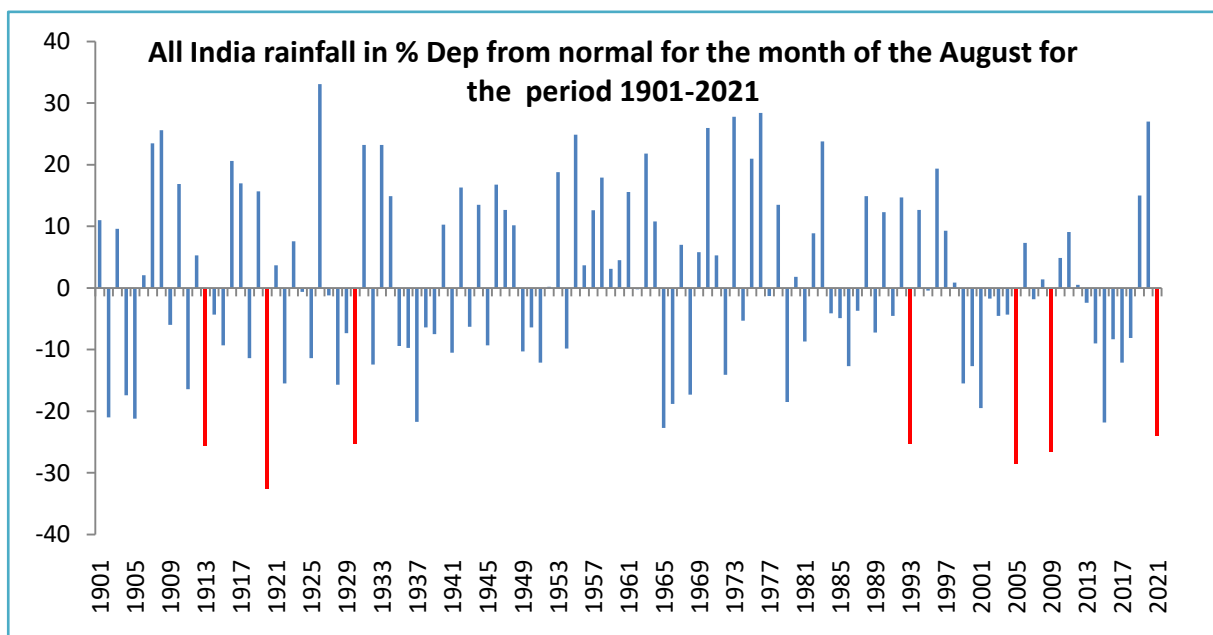


Fig. 1: All India rainfall % dep for Aug month in 1901-2020

Fig 2 shows week by week rainfall progress over India. It shows that weekly monsoon rainfall activities were largely subdued consecutively for three weeks i.e. for week ending on 11 Aug, 18 Aug and 25 Aug 2021, when all India **Weekly cumulative rainfall** for the country as a whole were 35%, 36% and 21% below its Long Period Average (LPA) and the seasonal cumulative rainfall from 1st June was 2%, 6%, 9% and 10% below the LPA (Fig 2).

Details of the rainfall distribution over the four broad geographical regions of India are given in **Table 1** and Met sub-division-wise rainfall for the month given in **Fig 3**. During this month, 4 sub-divisions received excess, 14 sub-divisions normal rainfall while remaining 18 sub-divisions received deficient/ large deficient rainfall. **Fig 4** shows grid point based spatial distribution of observed rainfall over India during Aug 2021. Below normal rainfall was observed over many parts of central India, Jammu and Kashmiri, Ladakh, Himachal Pradesh and Punjab and over many parts of Gujarat, Odisha, west coast while normal to above normal

rainfall was observed over many parts of southeast India, northeast India, foothills of the Himalayas and northwest Madhya Pradesh.

Table 1: Rainfall for the month of Aug 2021

Regions	Actual Rainfall (mm)	Normal Rainfall (mm)	% Departure from LPA
Country as a whole	196.2	258.2	-24
Northwest India	140.6	202.7	-30.6
Central India	188.3	307.3	-38.7
South Peninsula	168.2	189.2	-11.1
East & northeast India	354.6	346	2.5

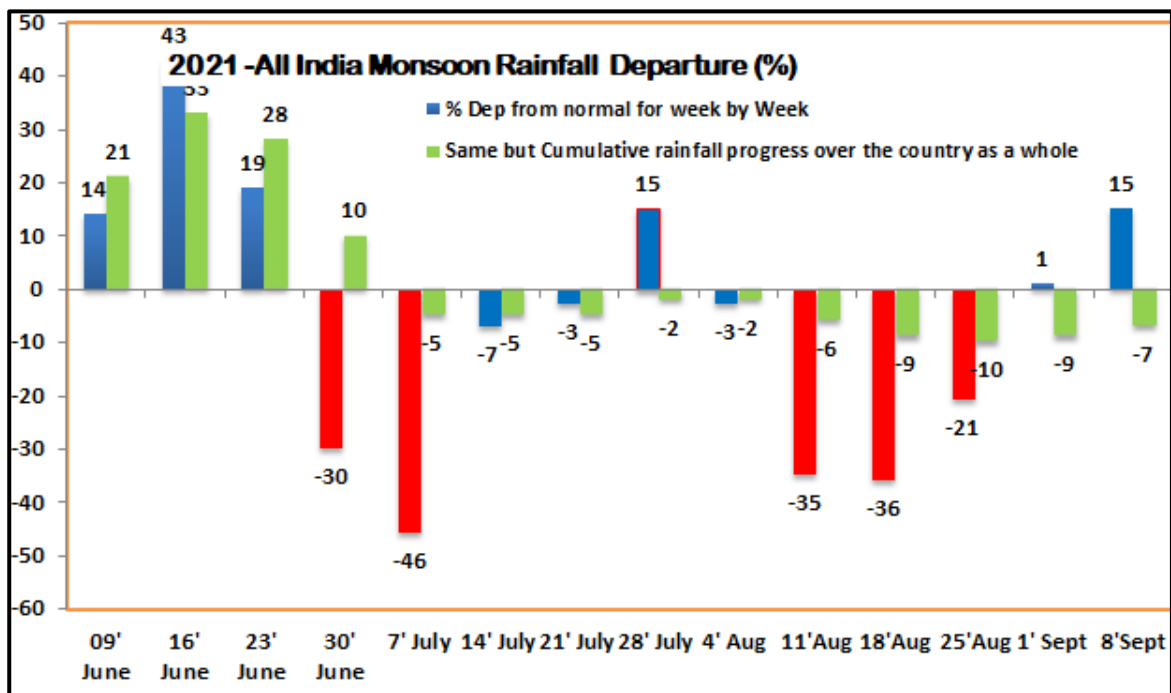
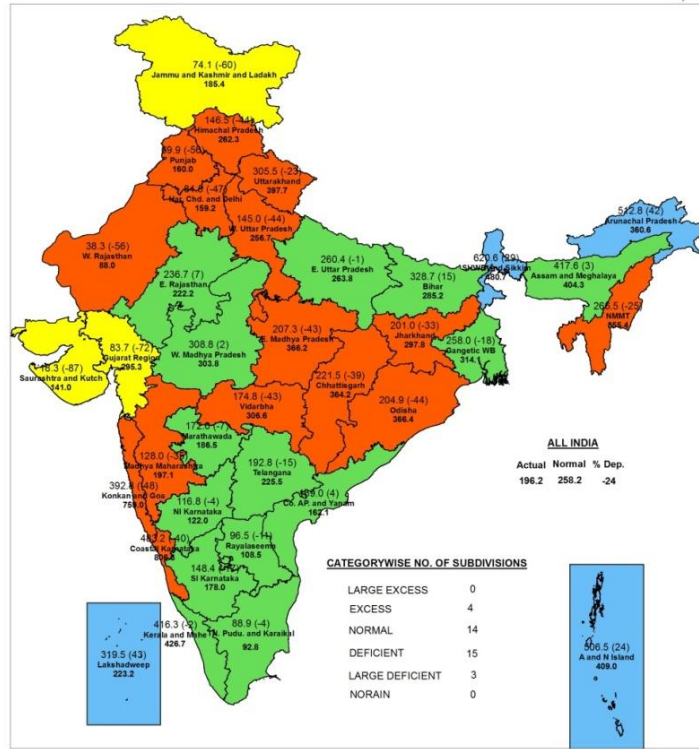


Fig 2 Week by week progress and cumulative rainfall all India in % Dep from normal over Country as a whole



SUBDIVISION RAINFALL MAP

Period : 01-08-2021 To 31-08-2021



Legend
Large Excess [60% or more] Excess [20% to 59%] Normal [-19% to 19%] Deficient [-59% to -20%] Large Deficient [60% to -80%] 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: Monthly Met-subdivision wise rainfall of Aug 2021

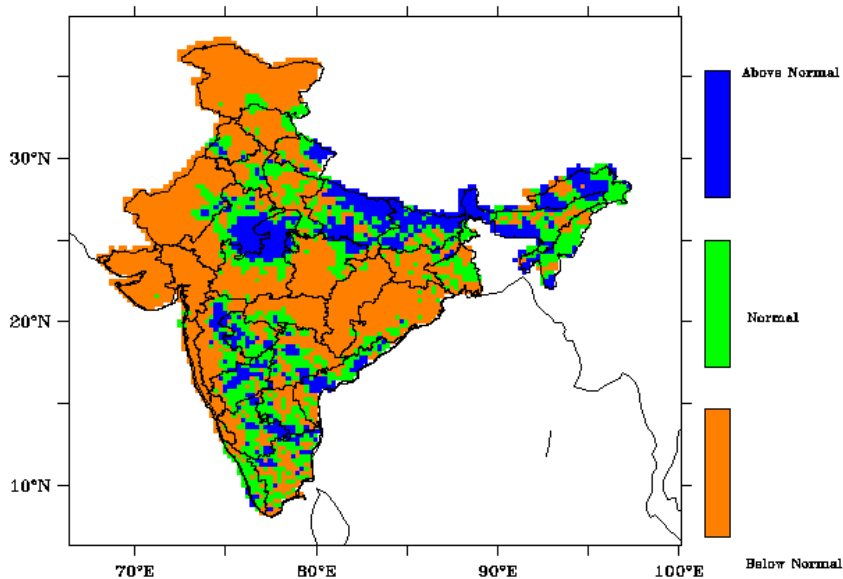


Fig. 4. Spatial distribution of observed Rainfall over India during Aug 2021

Heavy Rainfall Events:

August 2021 witnessed very heavy and extremely heavy rainfall events over West Madhya Pradesh, East Rajasthan, Sub Himalayan West Bengal & Sikkim, Assam & Meghalaya and Konkan & Goa. There were only 28 stations which reported extremely heavy rainfall (>204.5mm), 272 stations reported very heavy rainfall (115.6 to 204.4 mm) which were less as compared to its climatology. The location of occurrence of extremely heavy, very heavy and heavy rainfall events are shown in the **Figure 5**. The table below shows stations that received 24-hour record rainfall.

STATION	24 HOUR RECORD RAINFALL IN AUGUST 2021(mm)	DATE	PREVIOUS RAINFALL RECORD(mm)	DATE	YEAR
DELHI RIDGE	149.2	21	127.4	2	2007
CAR NICOBAR	123.2	19	73.2	16	2019
AIZWAL	161.7	3	137.4	11	1943
BUNDI	202	4	155	15	2019
THANJAVUR	141	25	115	14	2009
SHIVPURI	470	3	155	25	1991

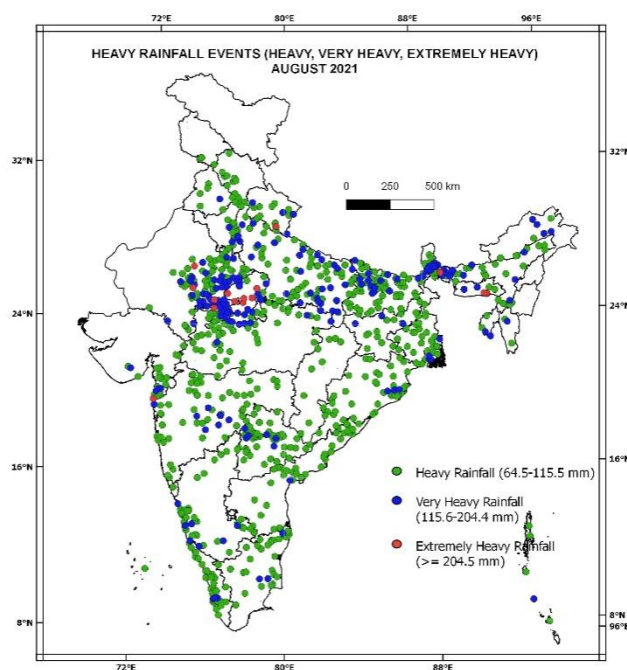


Fig 5: The location of occurrences of heavy, very heavy and extremely heavy rainfall events in the month of August 2021

Prolonged Spell of persistent heavy to extremely heavy rainfall event was observed over east Rajasthan and West Madhya Pradesh during 29 July-11 Aug 2021 **causing large-scale**

flooding over these areas with peak during 1-6 Aug 2021. The rainfall was mainly caused by both Arabian Sea and Bay of Bengal monsoonal winds at lower and middle levels in association with west-ward movement of the 1st well-marked low pressure area which lay over Jharkhand on 30th and very slowly moved over to northwest Madhya Pradesh during 2 to 6 August.

3. Low pressure Systems and Monsoon Trough

An LPS had formed over north Bay of Bengal on 27 July, which then gradually moved over central parts of north Madhya Pradesh & neighbourhood and it remained practically stationary over Northwest Madhya Pradesh during 2 to 6 Aug leading to rainfall over a limited area and hence flood situation over that region. It then became less marked and its remnant as cyclonic circulation moved east-northeastwards to Bihar during 07th-11th August across northeast Madhya Pradesh and East Uttar Pradesh.

Two low pressure systems (LPS) formed during the month of the Aug 2021 against its normal of 4 for the month. Both the LPSs (16-18 Aug and 28-30 Aug) were very short lived with just 3 days each. Thus, total 13 number of LPS days was observed in Aug 2021 against normal of 17 LPS days.

Though, the 2 LPSs of August were observed over northwest and adjoining west central Bay of Bengal off south Odisha- north Andhra Pradesh coasts, but both were weakened in just 2 days after entering to Chhattisgarh areas. Then, it was their remnants as cyclonic circulation which moved westwards upto Rajasthan and Kutch areas during 19-23 Aug and 31-3 Sept 2021 respectively along the monsoon trough, enhancing rainfall activity over central and northwest India.

In last 5 years of 2017-2021, years when none of the low-pressure systems intensified into a depression are 2017, 2020 and 2021. The formation of less number of LPS and their less number of days compared to the climatology during the month of August 2021 contributed to the large deficient rainfall in central India as well as all India.

Week by week variation shows two major weak monsoon spells prevailed over the country i.e. 9-16 and 23-27 Aug, when Northwest, Central and adjoining Peninsular and West coast of India had subdued rainfall activities. It was mainly due to location of the monsoon trough lying close to the foot hills of the Himalayas or north of its normal position, absence of any major monsoon system over the region, absence of easterly winds from Bay of Bengal over north India and weak pressure gradient and absence of off-shore trough along West coast of India.

During the weak monsoon conditions, due to movement of the eastern end of the monsoon towards the northeast India, strong southerly winds/southwesterly from Bay of Bengal continued to prevail over northeast India and Sub-Himalayan West Bengal & Sikkim during most days in 10-19 Aug and 23-27 Aug causing isolated heavy to very heavy rainfalls with isolated extremely heavy rainfall over these areas during the week.

4. Large scale features

El-Nino Southern Oscillation (ENSO):

In Aug 2021, neutral El-Nino Southern Oscillation (ENSO) conditions were observed over the equatorial Pacific. In the month, Equatorial Sea Surface Temperatures (SSTs) were near-to-below average across most of the equatorial Pacific Ocean, and were above-average in the western and far eastern Pacific Ocean, Atlantic Ocean and near Indonesia.

Indian Ocean Dipole (IOD):

The Indian summer monsoon rainfall is influenced by a system of oscillating SSTs known as the Indian Ocean Dipole (IOD) in which the western Indian Ocean becomes alternately warmer and then colder than the eastern part of the ocean. A positive IOD occurs when the sea surface temperatures over western equatorial Indian Ocean are greater than normal while eastern equatorial Indian Ocean is less than normal in the tropical Indian Ocean. When the reverse is the case, a negative IOD is said to have developed. Study shows positive IOD leads to good monsoon rainfall and more active (above normal rainfall) monsoon days while negative IOD leads to less rainfall and more monsoon break days. In Aug 2021, negative IOD conditions prevailed which could be associated with deficient rainfall in August 2021.

During Aug 2021, Surface skin temperature anomaly indicated cooler temperature anomaly over west equatorial Indian Ocean and warmer anomaly over Indonesia region. Analysis of satellite data shows Outgoing longwave radiation (OLR), a measure of Cloudiness shows a higher than normal OLR in the month for the Aug 2021 extended west-wards across central India and lay over North Bay of Bengal. It indicated the large scale subdued activity in terms of lower cloudiness over these areas.

Madden-Julian Oscillation (MJO):

The **Madden-Julian Oscillation** (MJO) is the major fluctuation in tropical weather on weekly to monthly timescales. The MJO can be characterized as an eastward moving 'pulse' of cloud and rainfall near the equator that typically recurs every 30 to 60 days. Study of Indian summer monsoon rainfall with MJO shows, about 83% of the break events were found to be set in during the Phases 7, 8, 1 and 2 of MJO with maximum during Phase 1 (40%) and during these phases, MJO became active mostly over Atlantic and African regions mainly covering western hemisphere. On the other hand, about 70% of the active events were set in during the MJO Phases of 3 to 6 with maximum during Phase 4 (21%). The latter areas cover North Indian Ocean and adjoining Pacific. In Aug 2021, **Unfavorable MJO conditions prevailed over Indian Ocean and during most of the days MJO was in the phase 8, 1 and 2 which were unfavorable for monsoon rainfall activity.**

5. Characteristics of Temperatures for the month of August 2021

The observed average maximum, average minimum and mean temperature for the country as a whole during August 2021 are 31.75°C, 24.39°C and 28.07°C respectively,

against the normal of 31.09°C, 24.01°C and 27.55°C based on period 1981-2010. Thus the average maximum, average minimum and mean temperature for the country as a whole were above normal by 0.66°C, 0.37°C and 0.52°C respectively. The climatological data based on the period of 1981 to 2010 are used to calculate the normal and hence the anomaly (Actual average temperature in 2021- normal temperature based on data of 1981-2010). The monthly average maximum, average minimum and mean temperature over all India for the month of August during 1901-2021 shows the average maximum temperature over all India is third highest (31.75°C) and average minimum temperature is eighth highest (24.39°C). The mean temperature over all India is third highest (28.07°C) since 1901. The average maximum temperature over Central India during August 2021 is second highest (31.25°C), while average minimum temperature is sixth highest (24.50°C) and average mean temperature is the third highest (27.88°C) since 1901.

The observed spatial temperature pattern of monthly average maximum, average minimum and mean temperature over India and their departures from normal (1981 to 2010 period) for the month of August 2021 is given in Figure 6.

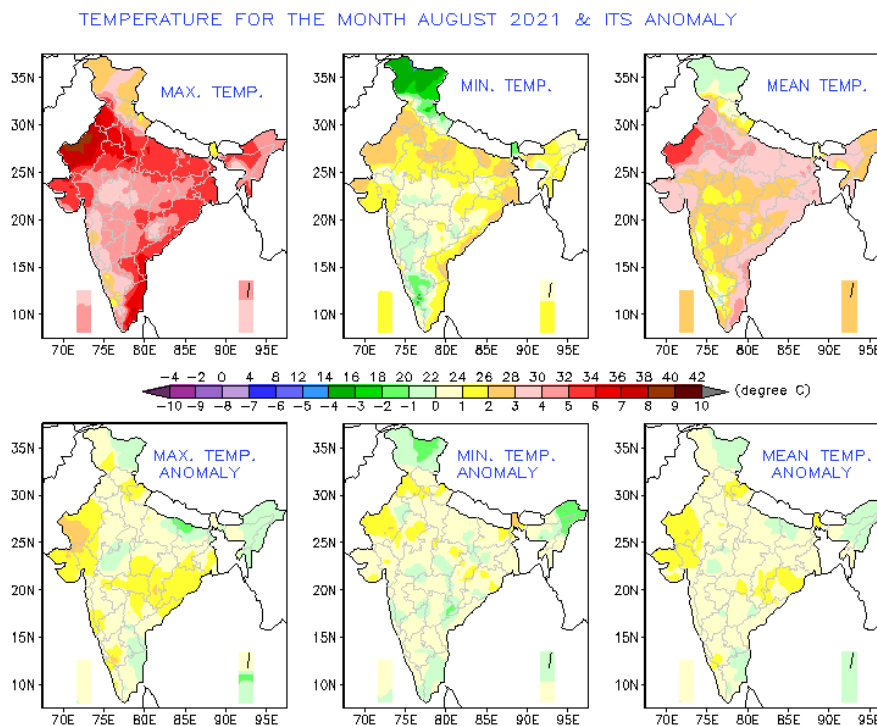


Fig 6: Observed spatial temperature pattern of monthly average maximum average minimum, and mean temperature over India (top three from left to right) and their departure from normal (1981 to 2010 period) for August 2021 (lower three from left to right).

6. Impact of Significant Weather Events for the month of August 2021

From 1st August to 30th August, total 121 persons lost their lives, 28 persons got injured, some persons missing & 21 livestock perished as per media report. The details of casualties are given below in Table 2, which are based on real time media reports.

Floods & Heavy Rain:Total 91 persons died, 13 persons injured, some persons are missed because of heavy rains, floods& landslide during 1st August to 30th August. In addition to this damage to crops, public & private property were reported. The details of the area effected by the events are summarised and given in the **Table 2;**

Table 2: Impact of heavy rainfall, flood and landslide in Aug 2021 as reported in Media

DATE	DEATH	INJURED	DISTRICT (STATE) AFFECTED
1 to 7 Aug.	30		Ashoknagar, Bhind, Datia, Gwalior, Guna, Morena, Rewa, Sheopur, Shivpuri, Singrauli (Madhya Pradesh)
11 Aug.	25	13	Kinnaur (Himachal Pradesh)
2 & 3 Aug.	15		East Bardhaman, Howrah, Hooghly, North 24 Parganas, South 24 Parganas, West Bardhaman (West Bengal)
7 to 17 Aug.	12		Begusarai, Bhagalpur, Bhojpur, Buxar, Darbhanga, Katihar, Khagaria, Lakhisarai, Munger, Muzaffarpur, Patna, Saharsa, Samastipur, Saran, Vaishali (Bihar)
1 to 9 Aug.	9		21 districts of Uttar Pradesh including Baghpat, Ballia, Budaun, Gonda, Etawah, Prayagraj {Allahabad}

Lightning:Total 30 persons died, 15 injured & 21 livestock perished during 1st August to 30th August because of Lightning. The details of the area effected by the events are summarized in the **Table 3**;

Table 3: Lightning Deaths as reported for the month fo the Aug 2021

DATE	DEATH	INJURED	LIVESTOCK PERISHED	DISTRICT(STATE) AFFECTED
2 &7Aug.	10	3		Dumka, Giridih, Hazaribagh, Palamu (Jharkhand)
2 &7Aug.	7	7		Birbhum, PurbaBardhaman, PurbaMedinipur (West Bengal)
7 Aug.	7			Banka (Bihar)
7 Aug.	5	5		Balasore, Bhadrak, Mayurbhanj (Odisha)
11& 20Aug.	1		21	Madurai , Tuticorin (Tamil Nadu)

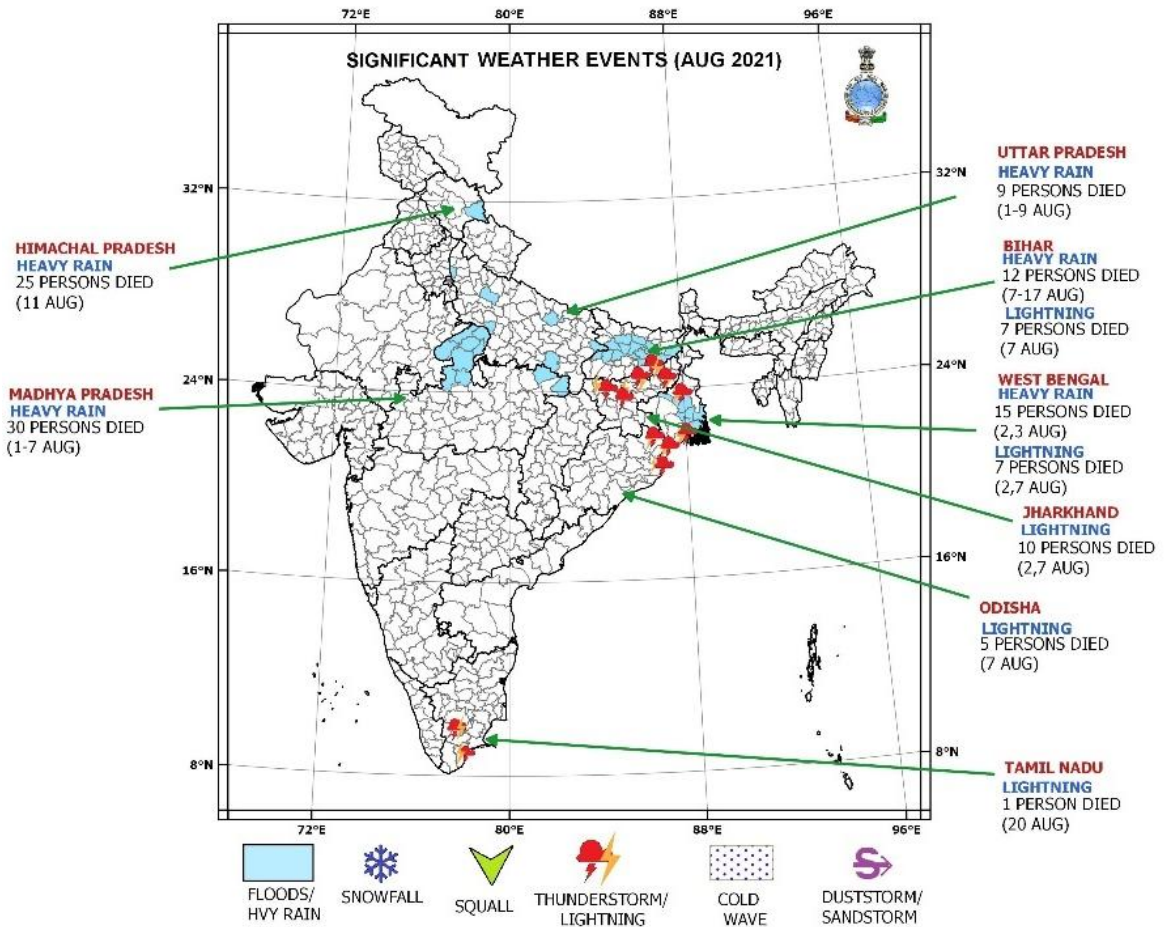


Fig 7: Significant weather events during August 2021 (on real-time media report)

5. Weather Outlook for September 2021

Temperature Outlook

Fig. 8, Fig.9 and Fig.10 shows predicted sub-divisional probability and the subdivision averaged maximum, minimum and mean temperature anomalies (departures from the long term normal) respectively for the month of September 2021. The probability forecast for maximum temperature (Fig.8) indicates above normal maximum temperatures are likely over West Rajasthan and Punjab and remaining subdivisions are likely to experience below normal or climatological probability for maximum temperatures.

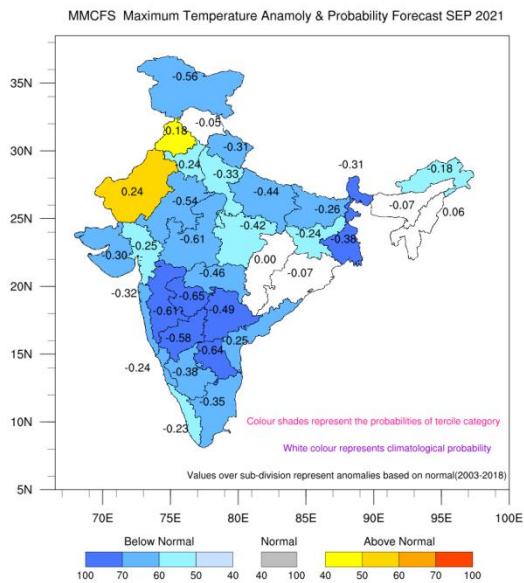


Fig8. Probability forecast &Subdivision averaged Maximum Temperature Anomaly for September 2021

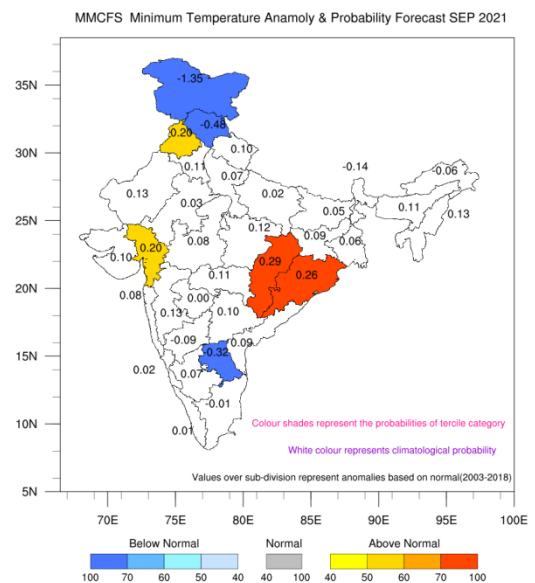


Fig9. Probability forecast &Subdivision averaged Minimum Temperature Anomaly for September 2021

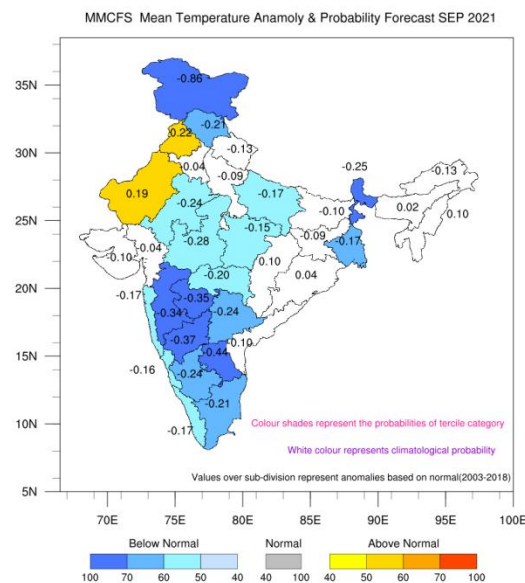


Fig 10. Probability forecast &Subdivision averaged Mean Temperature Anomaly for September 2021

The probability forecast for minimum temperature (Fig.9) indicates that above normal minimum temperatures are likely over the sub divisions of Punjab, Gujarat region, Chattisgarh and Odhisha. Few sub divisions of North India (Jammu& Kashmir and Ladhak, Himachal Pradesh)and one sub division (Raylaseema) of southern peninsular India are likely to experience below normal minimum temperature. Remaining subdivisions are likely to experience climatological probability for minimum temperatures.

The probability forecast for mean temperature (Fig.10) indicates that above normal mean temperatures are likely over West Rajasthan and Punjab and remaining subdivisions are likely to experience below normal or climatological probability for mean temperatures for September 2021.

Monthly rainfall outlook for the month of the Sept 2021

Refer https://internal.imd.gov.in/press_release/20210901_pr_1218.pd for details which has already been issued on 1 Sept 2021.