भारत सरकार
Government of India
पृथ्वी विज्ञान मंत्रालय (एम. ओ. ई. एस.)
Ministry of Earth Sciences (MoES)

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT
Climate Research and Services (CRS)

Monthly Climate Summary for September 2024

1. Monthly Rainfall Scenario (September 2024)

Rainfall over the country as a whole for the month of September 2024 was 187.3 mm which is 12% more than its Long Period Average (LPA) of 167.9 mm. Daily variation of the rainfall over the country as a whole during the month of September 2024 is presented in Fig. 1(a). The all India rainfall percentage departure from normal for September during 1901-2024 is presented in Fig. 1(b). September Rainfall over All India (187.3 mm) was 41st highest since 1901 and 10th highest since 2001 (Fig. 1c). Rainfall over homogeneous region of Northwest India (132.7 mm) was 35th highest since 1901 and 6th highest since 2001 (Fig. 1d). Meanwhile, rainfall over Central India (235.0 mm) was 26th highest since 1901 and 6th highest since 2001 (Fig. 1e). However, the East & Northeast India received less rainfall (231.2 mm) which was 23rd lowest since 1901 and 9th lowest since 2001(Fig. 1f).

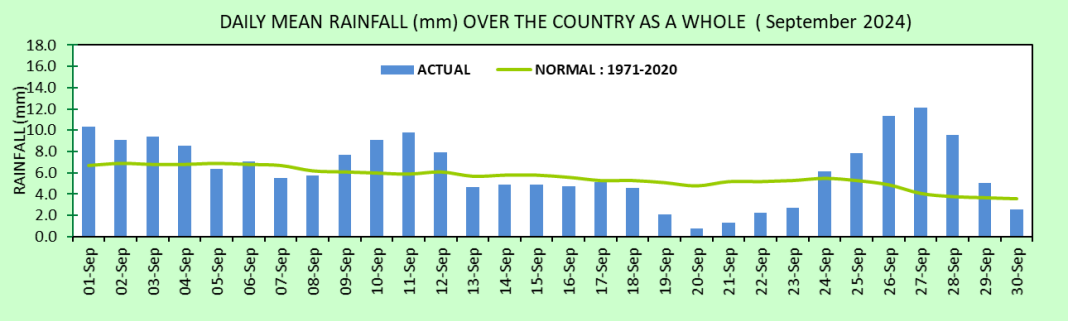


Fig. 1(a): Daily variation of rainfall over the country as a whole during September 2024.

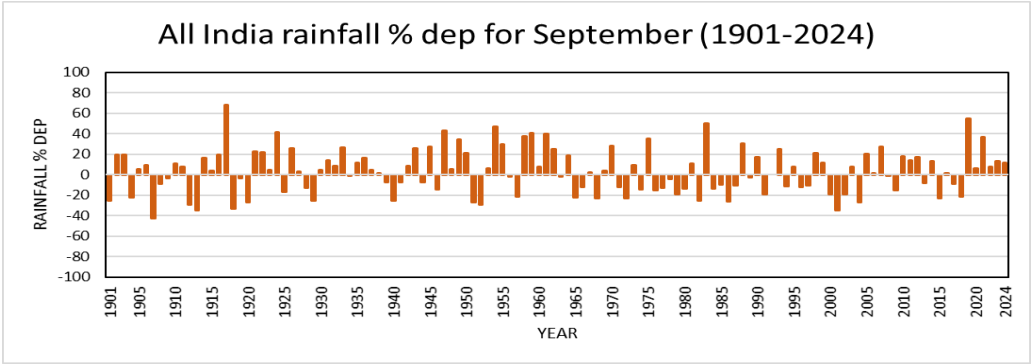


Fig. 1(b): All India monthly rainfall percentage departure from normal (1971-2020) for September from 1901-2024.

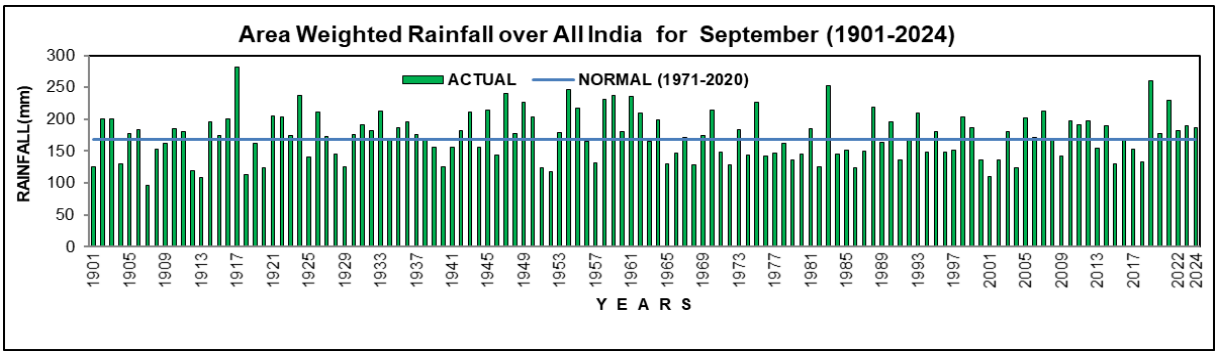


Fig. 1(c): Time series of area weighted rainfall over All India for September (1901 – 2024).

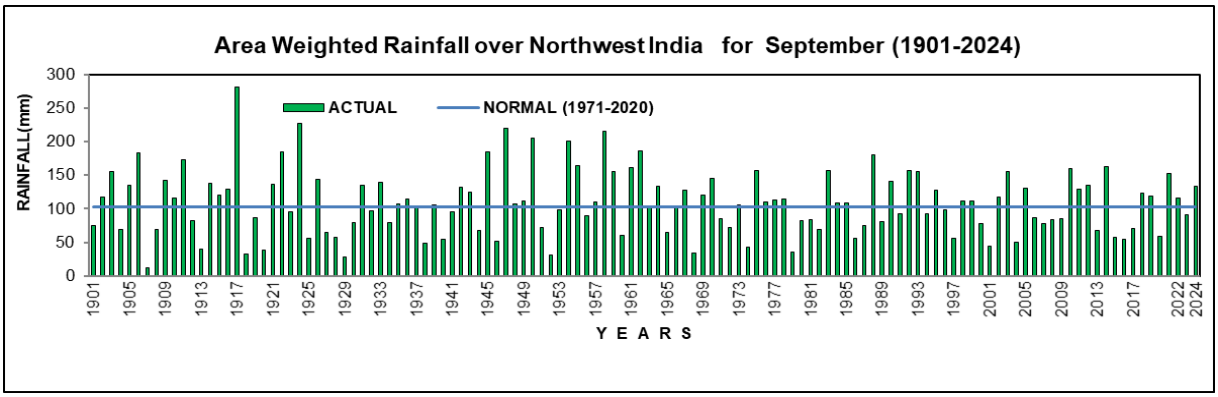


Fig. 1(d): Time series of area weighted rainfall over Northwest India for September (1901 – 2024).

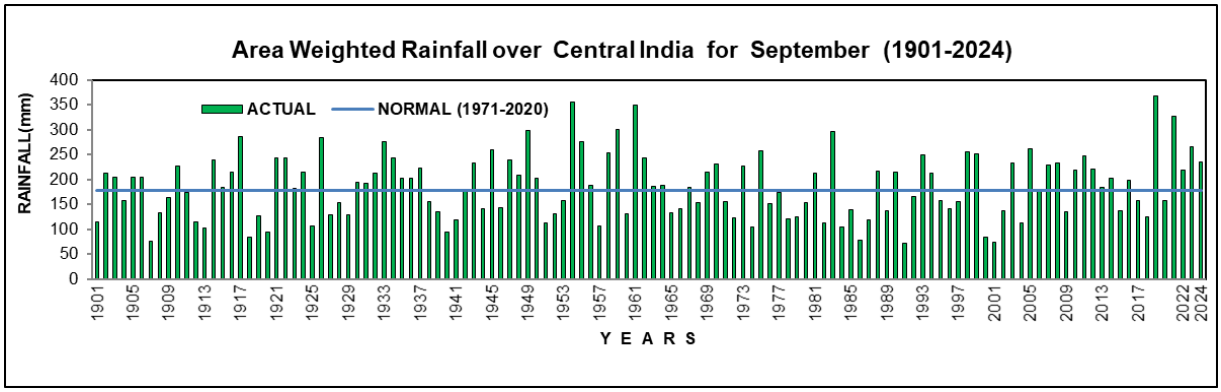


Fig. 1(e): Time series of area weighted rainfall over Central India for September (1901 – 2024).

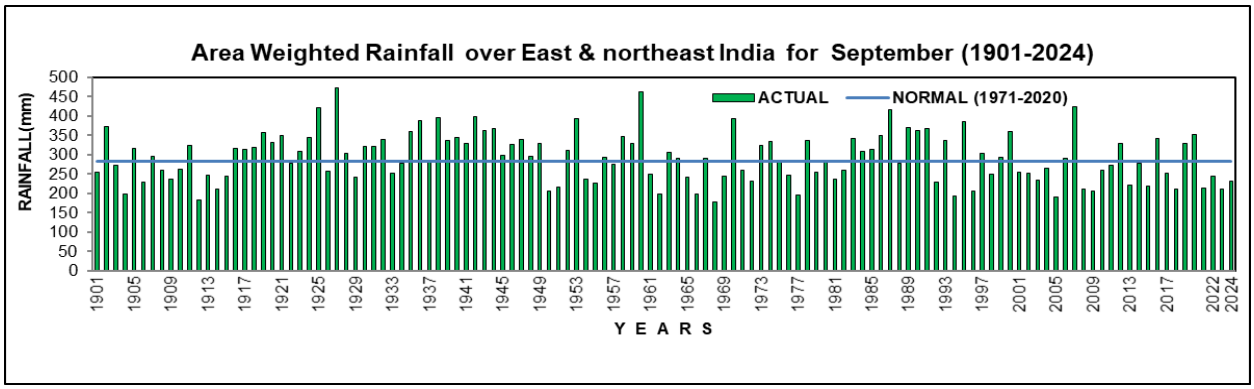


Fig. 1(f): Time series of area weighted rainfall over East & Northeast India for September (1901 – 2024).

Monthly rainfall for September 2024 is given in the table below:

Regions	Actual Rainfall (mm)	Normal Rainfall (mm)	% Departure from LPA
Country as a whole	**187.3**	**167.9**	**11.6**
Northwest India	**132.7**	**102.7**	**29.2**
Central India	**235.0**	**177.6**	**32.3**
South Peninsula	**155.7**	**160.0**	**-2.7**
East & northeast India	**231.2**	**282.8**	**-18.2**

During this month, 5 sub-divisions received large excess, 12 received excess, 8 received normal, 10 received deficient rainfall and one sub-division received large deficient rainfall (Fig. 2).

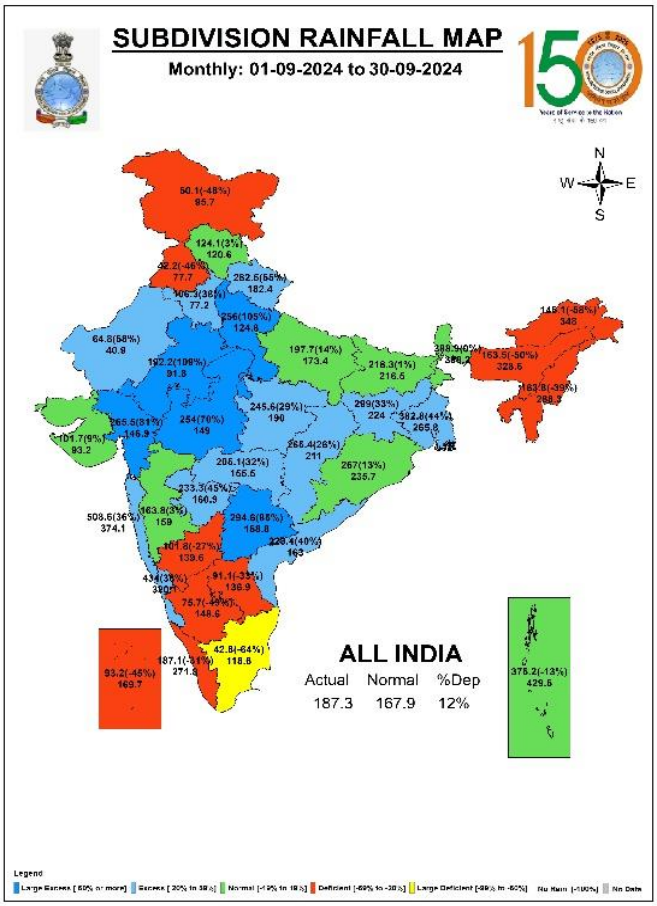


Fig. 2: Subdivision-wise rainfall distribution for September 2024.

The observed spatial distribution of rainfall during September 2024, normal rainfall based on data of 1971 to 2020 and rainfall departures from normal during September 2024 are shown in Fig. 3. The rainfall was normal/excess over 25 meteorological sub-divisions and deficient over 11 sub-divisions.

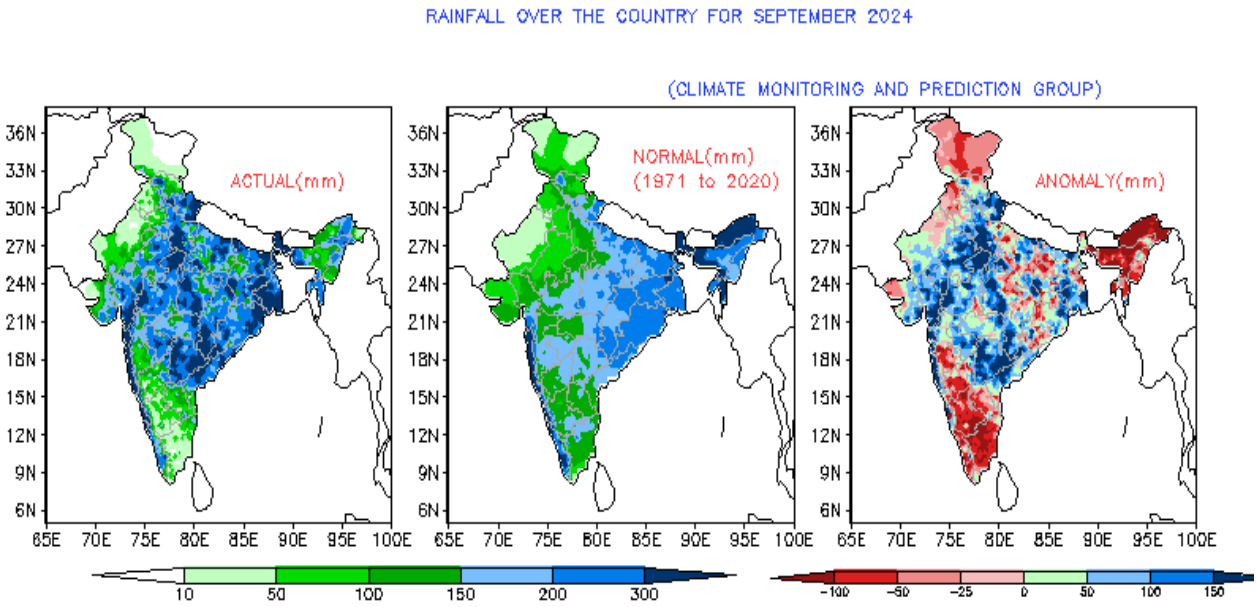


Fig. 3: Observed spatial Rainfall pattern for the month September 2024 over India and their departure from normal (1971 to 2020 period). Departure from normal is anomaly = actual rainfall - normal rainfall.

2. Frequency of Heavy Rainfall events

September 2024 witnessed extremely heavy rainfall events (>= 204.4 mm) mainly over Sub Himalayan West Bengal & Sikkim, Telangana, Bihar, East Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Gujarat. The very heavy rainfall events (115.6 – 204.4 mm) occurred over central parts of India, and heavy rainfall events (64.5 – 115.5 mm) were observed mainly over most parts except Ladakh. The location of occurrences of heavy, very heavy and extremely heavy rainfall events is shown in Fig. 4.

Out of total 1732 events, 92 were extremely heavy rainfall (>= 204.4 mm), 466 were very heavy rainfall (115.6 to 204.4 mm) and 1174 were heavy rainfall (64.5 to 115.5 mm) categories during this month.

Major heavy rainfall event of Sept which caused severe impacts were:

a) **Heavy rainfall over Andhra Pradesh & Telangana**

Extremely heavy to very heavy rainfall was recorded over Coastal Andhra Pradesh & Yanam on 1st September; Telangana on 1st and 2nd September. Based on 24-hour accumulated rainfall ending at 0830 IST of 1st September, Exceptionally heavy rainfall was recorded over Telangana {Malyal (dist Mahabubabad) 40 cm, Mahabubabad (dist Mahabubabad) 37 cm, Kodada (dist Suryapet) 35 cm, Manuguru (dist B. Kothagudem) 32 cm, Kusumanchi (dist Khammam) 32 cm, Chilkur (dist Suryapet) 31 cm, Mattampally (dist Suryapet) 30 cm, Huzur Nagar (dist Suryapet) 30 cm}. This has caused severe riverine and urban floods over parts of Andhra Pradesh.

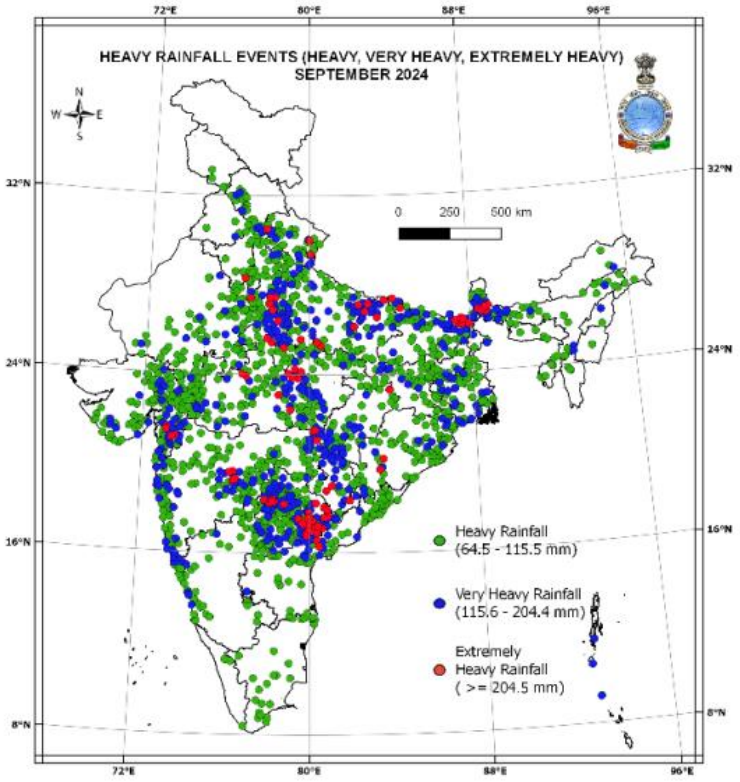
b) **Heavy rainfall over West Madhya Pradesh, West Uttar Pradesh, Uttarakhand & East Rajasthan**

Exceptionally heavy rainfall was recorded over West Madhya Pradesh (Biaora dist

Rajgarh 36 cm) on 12th September, Extreme heavy rainfall over West Uttar Pradesh on 12th & 18th September; East Rajasthan & Madhya Pradesh on 12th September; Haryana on 14th September; Uttarakhand on 13th September.

c) **Heavy rainfall over Bihar, East Uttar Pradesh, SHWB & Nepal**

Exceptionally heavy rainfall occurred over Bihar on 27th September {Forbesganj (dist Araria) 34, Jokihat (dist Araria) 31, Chargharia (dist Kishanganj) 29, Palasi (dist Araria) 28, Raniganj (dist Araria) 27, Tedhagach (dist Kishanganj) 27, Kochadhaman (dist Kishanganj) 25, Kursakanta (dist Araria) 23}. Extremely heavy rainfall was recorded over Bihar on 27th and 28th September; East Uttar Pradesh during 27th to 29th September; Sub-Himalayan West Bengal & Sikkim on 28th September. There was also heavy rainfall activity over Nepal during 26th – 28th September. It caused massive flooding in different rivers and loss of lives in Nepal. This flood also impacted Bihar.



(Only highest category of rainfall event considered for a station)

Fig. 4: The location of occurrences of heavy, very heavy and extremely heavy rainfall events in the month of September 2024.

3. Chief Synoptic weather features observed during September 2024

In September, three low-pressure systems formed. The country as a whole received excess rainfall during September mainly due to the west/north-westward movement of three low-pressure systems and their associated cyclonic circulations along the monsoon trough from the Northwest Bay of Bengal towards central India. Out of these two systems intensified into the deep depression.

a. **Deep Depression over Westcentral & adjoining Northwest Bay of Bengal (8th- 10th September & 11th - 13th September 2024)**

A depression formed over northwest & adjoining westcentral Bay of Bengal on 8th September. It moved west northwestwards over Gangetic West Bengal, Jharkhand, north Chhattisgarh, north Madhya Pradesh, south Uttar Pradesh and weakened into a well-marked Low pressure area on the evening of 10th September over northeast Madhya Pradesh & neighbourhood. It re-intensified into a Depression on morning of 11th September over Northeast Madhya Pradesh and moved northwest Madhya Pradesh during 11th -12th September and weakened into a well-marked low-pressure area over northwest Uttar Pradesh & neighborhood on 13th September.

b. **Deep Depression over Northeast Bay of Bengal & adjoining Bangladesh during 12th – 19th September**

A depression formed over northeast Bay of Bengal adjoining Bangladesh on 12th September and moved across central India and weakened into a well-marked Low Pressure Area over northeast Madhya Pradesh and adjoining southwest Uttar Pradesh on 19th September.

c. **Low Pressure Area over Westcentral Bay of Bengal & adjoining Northwest Bay off north Andhra - south Odisha coasts**

A low pressure area was formed over westcentral Bay of Bengal & adjoining northwest Bay of Bengal off north Andhra - south Odisha coasts, which moved towards south Chhattisgarh & neighborhood across Odisha on 25th September and became less marked thereafter on 26th September.

Besides above three systems, 2 systems were continued from previous month of Aug 2024:

a. **Remnant of Cyclonic Storm "ASNA"** from last week of August 2024, further weekend during 1-4 September from Deep Depression to Low Pressure System over the Northeast Arabian Sea.
b. **Remnant of Depression from August,** which crossed north Andhra Pradesh & south Odisha coasts near Kalingapatnam during early hours of 1st September, moved west-northwestwards and weakened into a Well-Marked Low Pressure Area over central parts of Vidarbha on 2nd September, 2024.

During the month of September 2024, there were five WDs (1-7, 8-13, 13-19, 16-18 and 28-29 September moved across extreme north India and 3 WDs (8-13, 13-19, 16-18) interacted with monsoonal low pressure areas.

Tracks of these systems are presented in Fig. 5.

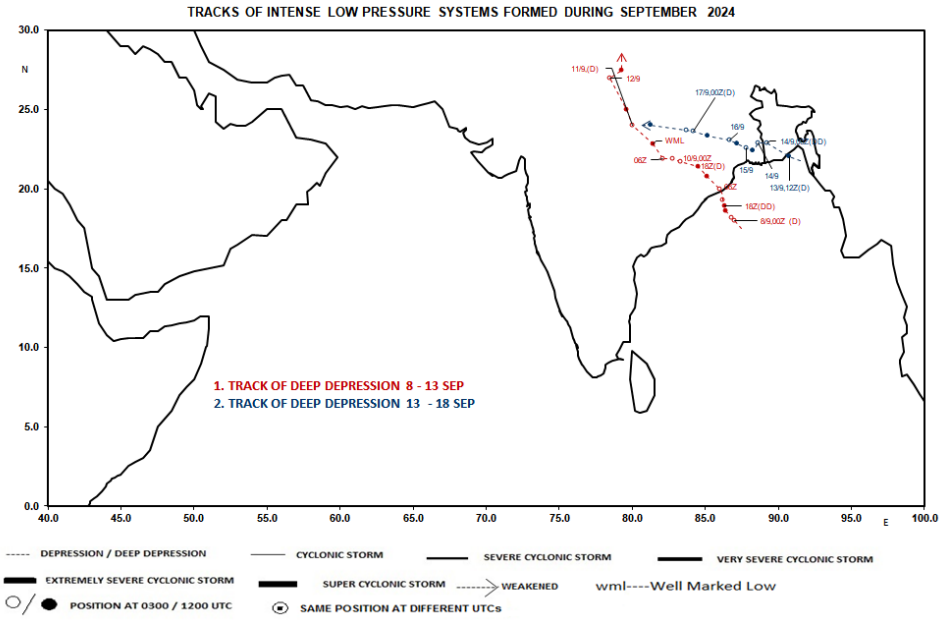


Fig. 5: Tracks of intense low pressure systems formed during September 2024

4. Withdrawal of Southwest Monsoon 2024.

With the reduction in the rainfall and formation of the anti-cyclonic circulation in lower troposphere, withdrawal of the southwest monsoon 2024 began from West Rajasthan and Kachchh on 23rd September against the normal date of 17th September. The withdrawal dates of the Southwest monsoon season 2024 as on 30th September are shown in Fig. 6.

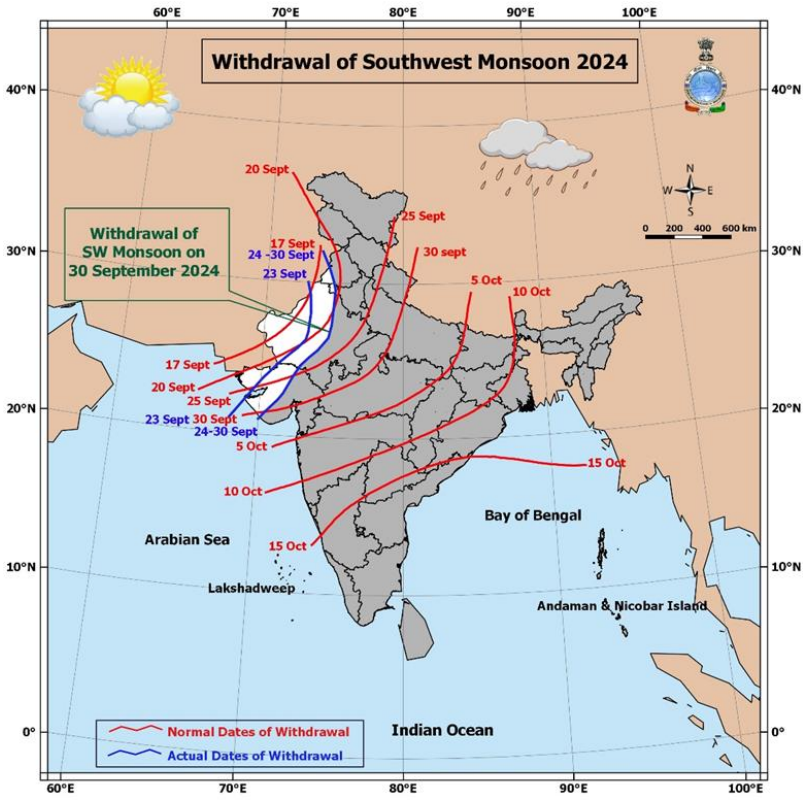


Fig. 6: Isochrones of withdrawal of Southwest Monsoon 2024 as on 30th September, 2024

5. Characteristics of Temperatures for the month of September 2024

The average maximum, average minimum and mean temperature for the country as a whole during September 2024 were 31.96ºC, 23.79ºC and 27.88ºC respectively, against the normal of 31.43ºC, 22.80ºC and 27.12ºC based on data of 1991-2020. Thus, the average maximum, average minimum and mean temperature were above normal with departure from normal of 0.53ºC, 0.99ºC and 0.76ºC, respectively for the country as a whole. The daily variation of maximum and minimum temperature departure from normal over the country as a whole for September 2024 is shown in Figs. 7(a) and (b), respectively.

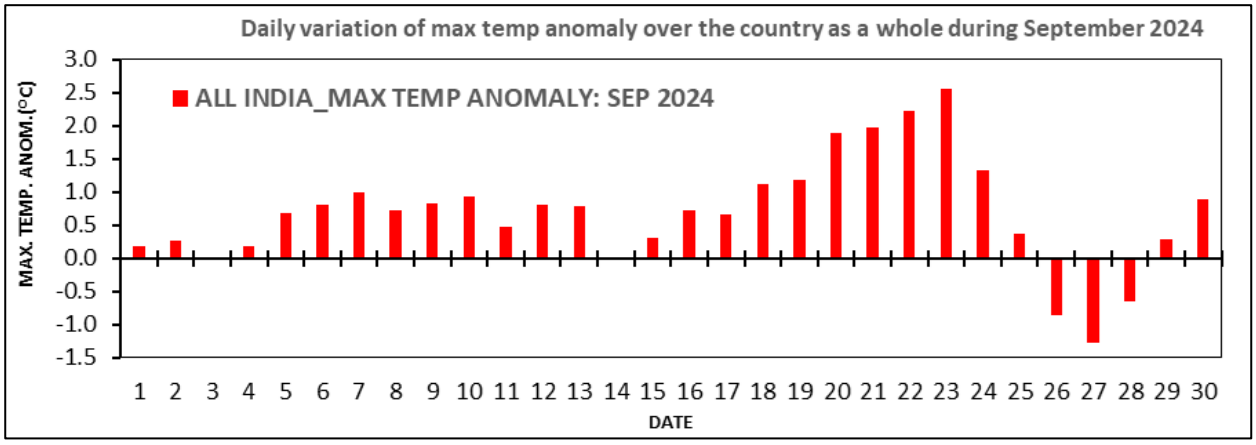


Fig. 7(a): Daily variation of maximum temperature anomaly (departure from normal) over the country as a whole for September 2024

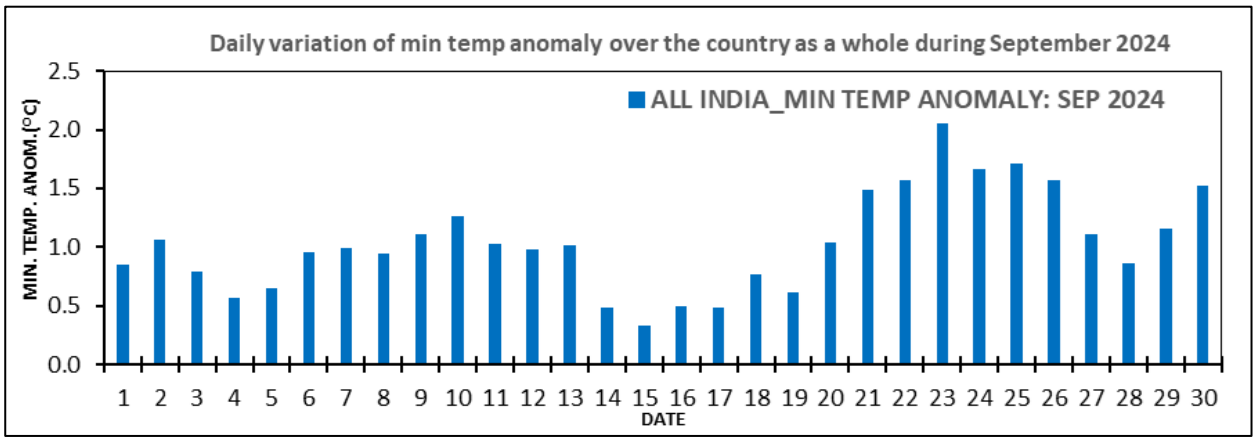


Fig. 7(b): Daily variation of minimum temperature anomaly (departure from normal) over the country as a whole for September 2024

Fig. 8 shows time series of monthly average maximum, average minimum and mean temperature over the country as a whole for the month of September 1901-2024. Over the country during September, the average maximum temperature was 31.96ºC with departure from normal of 0.53ºC (8th highest since 1901). The average minimum temperature was highest at 23.79ºC since 1901 against the earlier record of 23.68ºC in 2023. The mean temperature was 2nd highest (27.88ºC with departure from normal of 0.76ºC) after the year 2023 (27.93ºC) since 1901.

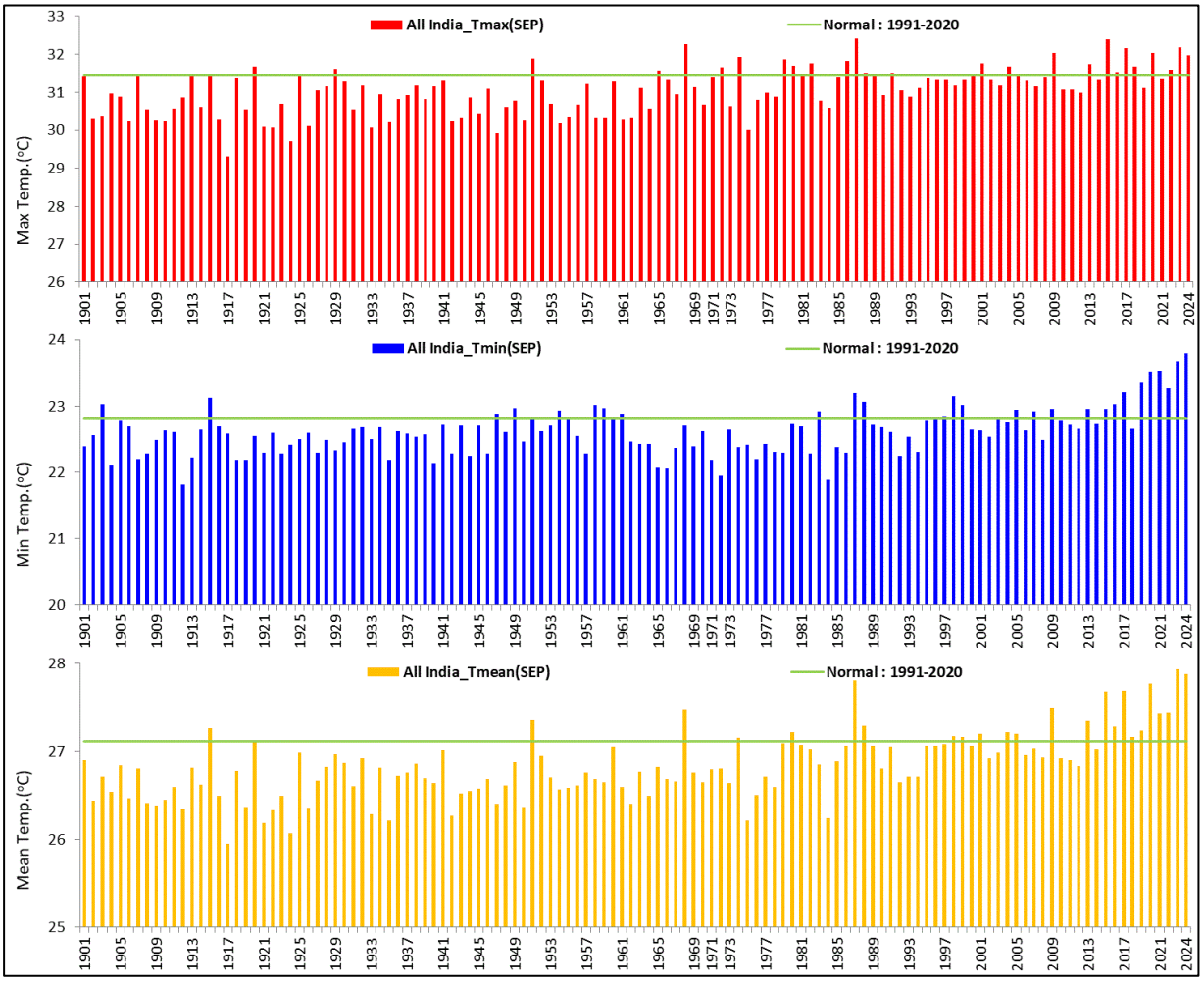


Fig. 8: Time series of monthly average maximum, average minimum and mean temperature over the country as a whole for the month of September 1901-2024

Fig. 9 shows the time series of average maximum, average minimum and mean temperature over the East & Northeast India for the month of September 1901-2024. Over East & Northeast India, the average maximum temperature was highest (32.59ºC) since 1901 against the earlier record of 32.47ºC in 2023. The average minimum temperature was also highest (24.93ºC) since 1901 against the earlier record of 24.72ºC in 2023. The mean temperature was highest (28.76ºC) since 1901 against the earlier record of 28.60ºC in 2023.

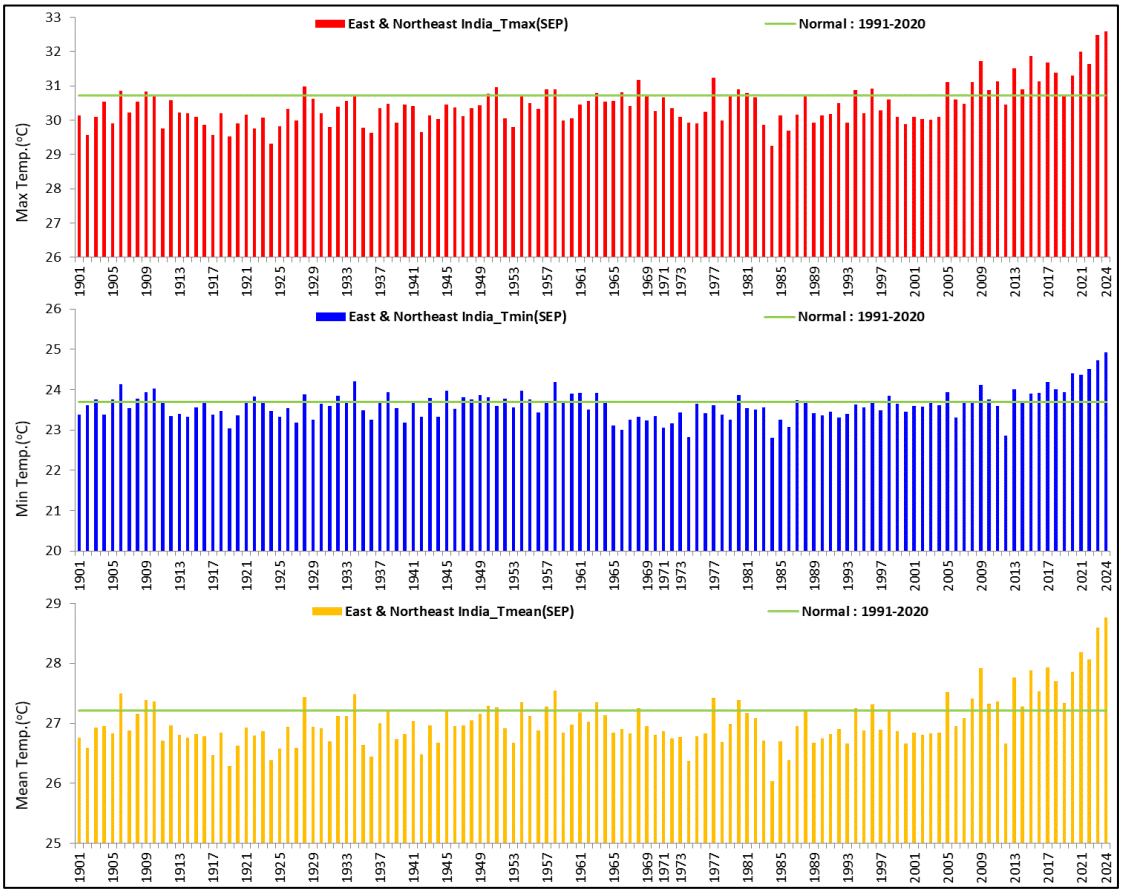


Fig. 9: Time series of monthly average maximum, average minimum and mean temperature over East & Northeast India for the month of September 1901-2024

Fig. 10 shows time series of average minimum and mean temperature over the South Peninsular India for the month of September 1901-2024. Over South Peninsular India during September, the average minimum temperature was highest (23.88ºC) since 1901 against the earlier record of 23.72ºC in 1987. The mean temperature was 2nd highest (27.96ºC) with departure from normal of 0.63ºC after the year 1987 (28.15ºC) since 1901.

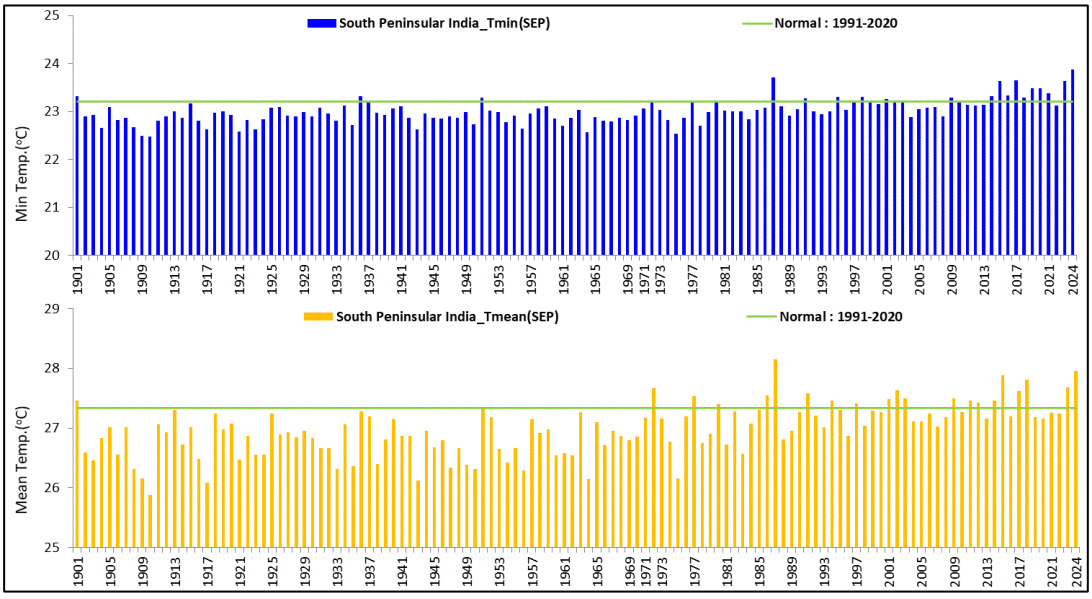


Fig. 10: Time series of monthly average minimum and mean temperature over South Peninsular India for the month of September 1901-2024

Fig. 11 shows time series of average minimum temperature over the Central India for the month of September 1901-2024. Over Central India, the average minimum temperature was 2nd highest (23.98ºC with departure from normal of 0.78ºC) after the year 2020 (24.02ºC) since 1901.

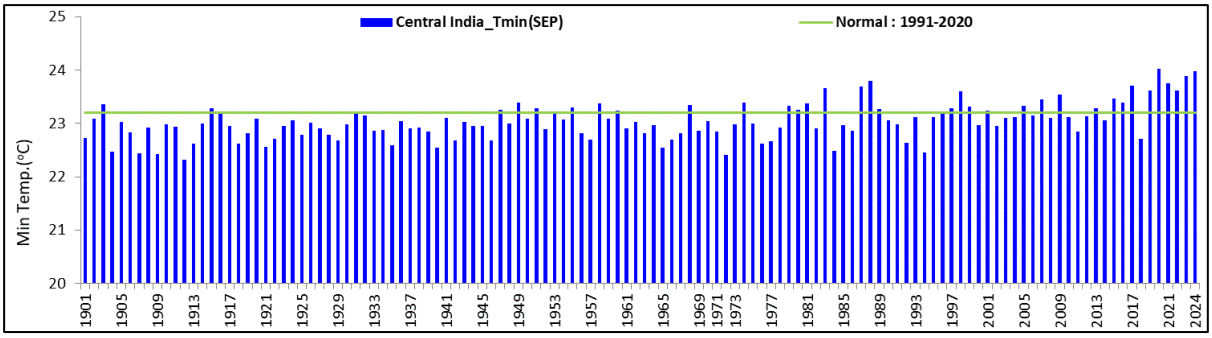


Fig. 11: Time series of monthly average minimum temperature over Central India for the month of September 1901-2024

Fig. 12 shows time series of average minimum temperature over the Northwest India for the month of September 1901-2024. Over Northwest India, the average minimum temperature was 3rd highest (22.84ºC with departure from normal of 1.29ºC) after 2023 (22.88ºC) and 2021 (22.86ºC) since 1901.

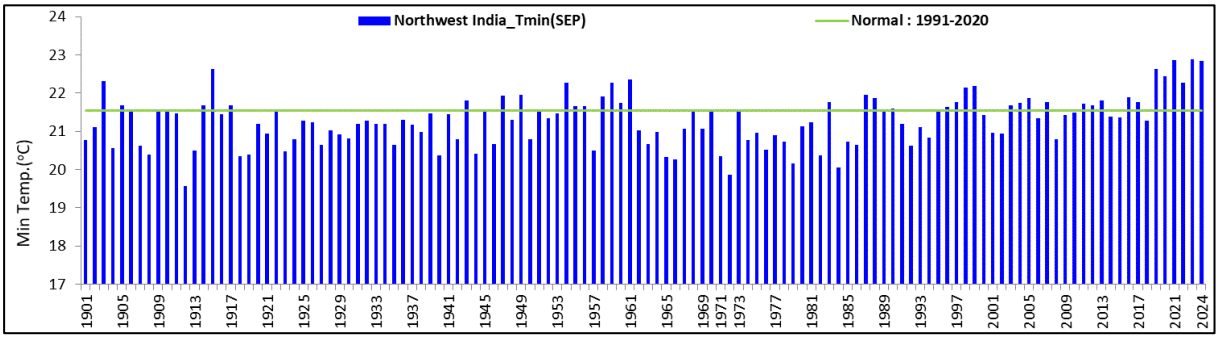


Fig. 12: Time series of monthly average minimum temperature over Northwest India for the month of September 1901-2024

The temperatures during September 2024 for all India and homogeneous regions with its top ranks since 1901 are given below:

SEP 2024		Max Temp (^{0}C)	Min Temp (^{0}C)	Mean Temp (^{0}C)
ALL INDIA	**ACTUAL**	**31.96**	**23.79**	**27.88**
	NORMAL	31.43	22.80	27.12
	ANOMALY	0.53	0.99	0.76
	Rank since 1901	**8**	**1**	**2**
NORTHWEST INDIA	**ACTUAL**	**31.95**	**22.84**	**27.40**
	NORMAL	31.72	21.55	26.63
	ANOMALY	0.23	1.29	0.76
	Rank since 1901	**38**	**3**	**6**
EAST & NORTHEAST INDIA	**ACTUAL**	**32.59**	**24.93**	**28.76**
	NORMAL	30.72	23.70	27.21
	ANOMALY	1.87	1.23	1.55
	Rank since 1901	**1**	**1**	**1**
CENTRAL INDIA	**ACTUAL**	**31.53**	**23.98**	**27.75**
	NORMAL	31.56	23.20	27.38
	ANOMALY	-0.03	0.78	0.37
	Rank since 1901	**42**	**2**	**12**
SOUTH PENNINSULAR INDIA	**ACTUAL**	**32.04**	**23.88**	**27.96**
	NORMAL	31.45	23.21	27.33
	ANOMALY	0.59	0.67	0.63
	Rank since 1901	**6**	**1**	**2**

Note: Values are rounded off to the nearest two decimals.

The five highest temperature records with corresponding top ranks since 1901 along with year of occurrence for East & Northeast India (Tmax, Tmin, Tmean), All India, South Peninsular India (Tmin, Tmean) and Central India, Northwest India (Tmin) are given in the table below:

All India (September2024)

Year	**TMin**	Normal	Anomaly	Rank
2024	23.79	22.80	0.99	1
2023	23.68		0.88	2
2021	23.52		0.71	3
2020	23.51		0.70	4
2019	23.35		0.55	5

East & Northeast India (September2024)

Year	TMax	Normal	Anomaly	Rank
2024	32.59	30.72	1.87	1
2023	32.47		1.75	2
2021	32.00		1.27	3
2015	31.86		1.14	4
2009	31.72		1.00	5

Central India (September2024)

Year	**TMin**	Normal	Anomaly	Rank
2020	24.02	23.20	0.82	1
2024	23.98		0.78	2
2023	23.88		0.68	3
1988	23.79		0.59	4
2021	23.75		0.55	5

All India (September2024)

Year	**TMean**	Normal	Anomaly	Rank
2023	27.93	27.12	0.82	1
2024	27.88		0.76	2
1987	27.80		0.68	3
2020	27.77		0.65	4
2017	27.69		0.57	5

East & Northeast India (September2024)

Year	**TMin**	Normal	Anomaly	Rank
2024	24.93	23.70	1.23	1
2023	24.72		1.02	2
2022	24.50		0.81	3
2020	24.40		0.70	4
2021	24.38		0.68	5

South Peninsular India (September2024)

Year	**TMin**	Normal	Anomaly	Rank
2024	23.88	23.21	0.67	1
1987	23.72		0.51	2
2017	23.65		0.44	3
2023	23.63		0.42	4
2015	23.63		0.42	5

Northwest India (September2024)

Year	**TMin**	Normal	Anomaly	Rank
2023	22.88	21.55	1.33	1
2021	22.86		1.31	2
2024	22.84		1.29	3
1915	22.64		1.09	4
2019	22.63		1.08	5

East & Northeast India (September2024)

Year	**TMean**	Normal	Anomaly	Rank
2024	28.76	27.21	1.55	1
2023	28.60		1.38	2
2021	28.19		0.98	3
2022	28.07		0.85	4
2017	27.94		0.72	5

South Peninsular India (September2024)

Year	**TMean**	Normal	Anomaly	Rank
1987	28.15	27.33	0.82	1
2024	27.96		0.63	2
2015	27.89		0.56	3
2018	27.81		0.48	4
2023	27.67		0.34	5

The observed spatial temperature patterns of monthly average maximum, average minimum and mean temperature over India and their departures from normal (1991 to 2020) for the month of September 2024 are given in Fig. 13.

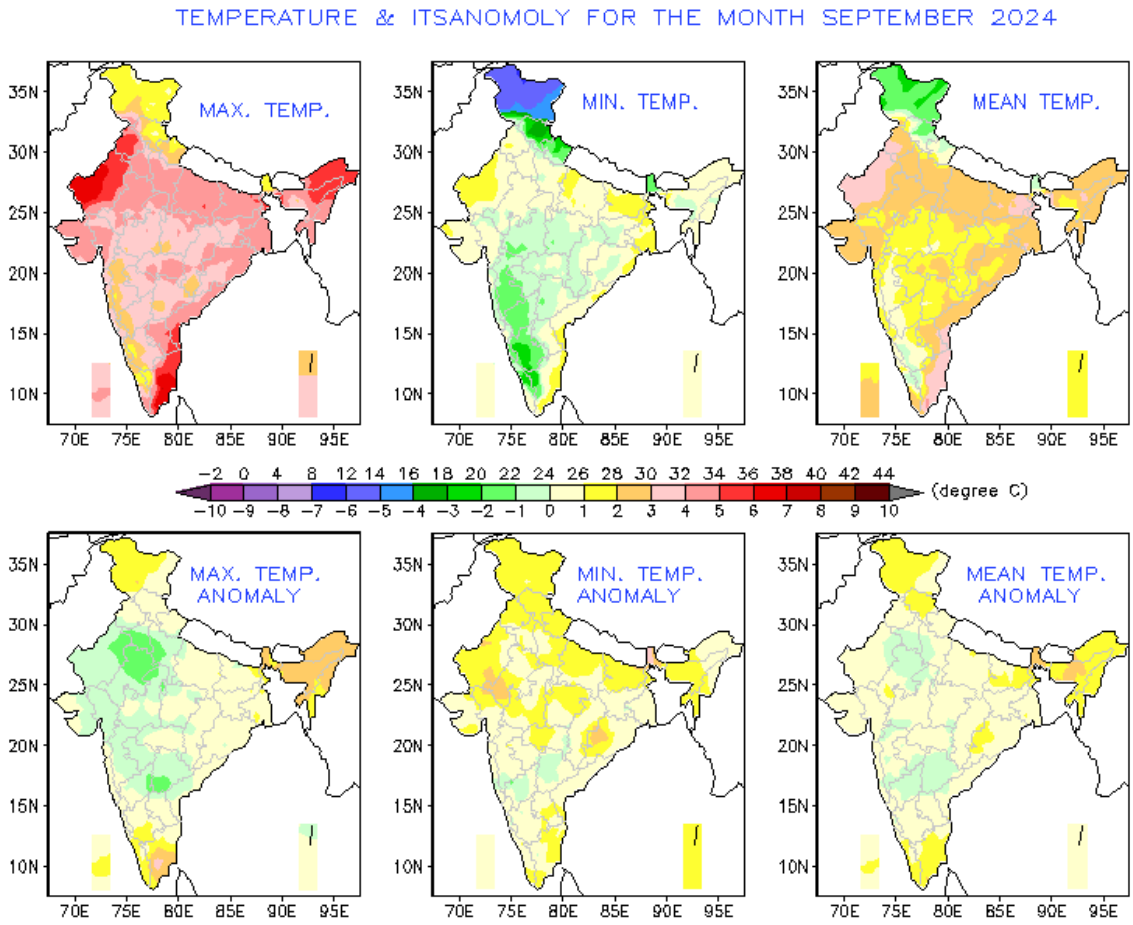


Fig. 13: Observed spatial temperature pattern of monthly average maximum, average minimum and mean temperature over India (top three from left to right) and their departure from normal (1991 to 2020 period) for September 2024 (lower three from left to right)

6. Significant Weather Events:

Fig 14 shows loss and damages due to significant weather events during September 2024. During September, more than 80 people reportedly died, more than 30 were injured and more than 88 livestock perished, as per media report. The details of event-wise casualties are given below. However, actual data on casualties and damages may be available with concerned state governments.

Event	Number of human deaths
Monsoon related Heavy Rains, Floods & Landslide	53 (Mainly Andhra Pradesh, Bihar, Jammu & Kashmir, Maharashtra, Telangana)
Lightning / Thunderstorm	28 (Mainly Chhattisgarh, Karnataka, Maharashtra)

There was also damage reported from different states as mentioned above due to above hazards.

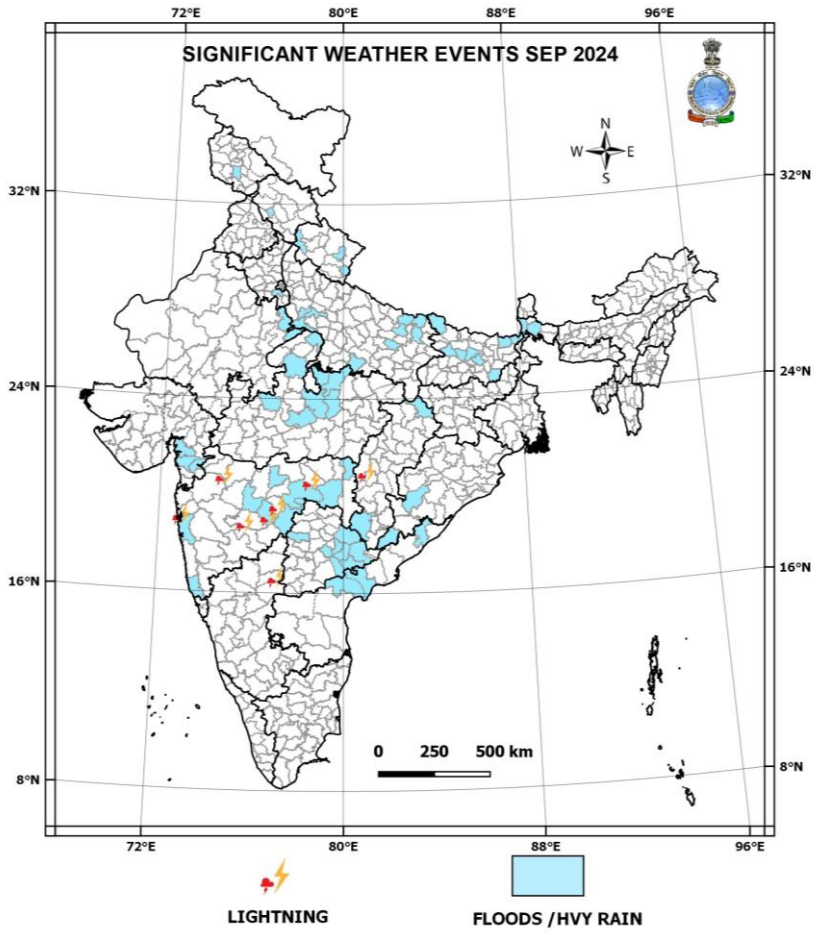


Fig. 14: Loss and Damages due to significant weather events during September 2024 (Based on real time media reports and real-time reports from various agencies)