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पृथ्वी प्रणाली विज्ञान संगठन / EARTH SYSTEM SCIENCE ORGANIZATION
भारत मौसम विज्ञान विभाग / INDIA METEOROLOGICAL DEPARTMENT







ANNUAL CLIMATE SUMMARY - 2019

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NATIONAL CLIMATE CENTRE, CLIMATE SERVICES DIVISION

जलवायु अनुसंधान तथा सेवाएँ का कार्यालय
OFFICE OF CLIMATE RESEARCH & SERVICES,

भारत मौसम विज्ञान विभाग
INDIA METEOROLOGICAL DEPARTMENT

पुणे - 411005
PUNE - 411005

COVER PHOTOS

① Photo 1 : A view of a flooded area following incessant rainfall in Kolhapur district during August 2019 (Image: PTI)
https://images.news18.com

② Photo 2 : Heavy rains have flooded Kerala's central and southern districts, inundating major roads, and disrupting train services and power supply. 21 Oct 2019
https://www.livemint.com

③ Photo 3 : Odisha received heavy rains due to cyclonic storm. Cut off several road link across the state.
https://akm-img-a-in.tosshub.com

④ Photo 4 : Jammu & Kashmir reels under cold wave during November 2019
https://www.thehindu.com

⑤ Photo 5 : Maharashtra experienced heat wave conditions during Apr- Jun 2019
https://akm-img-a-in.tosshub.com

⑥ Photo 6 : Jharakhand reeled under heat wave conditions with hot winds during April 2019

https://jharkhandstatenews.com

वार्षिक जलवायु सारांश - 2019

विशेषताएं:

वर्ष 2019 में देश का औसत तापमान, सन 1981-2010 के औसत से 0.36 डिग्री सेलशियस (डि.से.) से अधिक रहा। यह साल 1901 से अब तक का सातवाँ सबसे ऊष्ण साल रहा । मानसूनपूर्व ऋतु के औसत तापमान में वृध्दि (+0.39 डि.से.) और मानसून ऋतु के औसत तापमान में वृध्दि (+0.58 डि.से.) एवं 1901 से अब तक सबसे ऊष्ण ऋतु) वार्षिक तापमान में वृध्दि का मुख्य कारण है। अब तक के 10 सबसे ऊष्ण साल इस क्रम से है : 2016 (विसंगति +0.71 डि.से.), 2009 (+0.55 डि.से.), 2017 (+0.54 डि.से.), 2010 (+0.539 डि.से.), 2015 (+0.42 डि.से.), 2018 (+.40 डि.से.), 2019 (+0.36 डि.से.),1958 (+0.25 डि.से.), 2002 (+0.246 डि.से.) और 2014(+0.24 डि.से.) ।

दक्षिणी पश्चिमी मानसून ऋतु (जून-सितंबर, जो देश की वर्षा ऋतु का प्रमुख काल माना जाता है) में देशभर में व्यापक रुप से वर्षा सामान्य रही (दीर्घ काालावधि औसत के 110%)। हालांकि सामयिक रुप से वर्षा अस्थाई थी लेकिन फिर भी देश भर में वर्षा का वितरण काफी अच्छा रहा।

दक्षिण प्रायद्वीप (जिसमे 5 प्रभाग आते हैं, और जो उत्तर-पूर्व मानसून वर्षा का मुख्य क्षेत्र है, नामतः तटीय आन्ध्रप्रदेश, रायलसीमा, तमिलनाडु और पुडुचेरी, दक्षिणी आंतरिक कर्नाटक और केरल) में अक्तूबर से दिसंबर तक पडने वाली उत्तर-पूर्व मानसून वर्षा, सामान्य (दीर्घ कालावधि औसत के 109%) रही ।

वर्षा

2019 में देश भर में वार्षिक वर्षा सामान्य थी । वर्षा का परिमाण दीर्घ कालावधि औसत के 110% रहा । देश के 36 प्रभागों में से 2 प्रभाग सौराष्ट्र और कच्छ तथा मध्य महाराष्ट्र मे वर्षा अत्यधिक, 10 प्रभागों में अधिक, 21 प्रभागों में वर्षा सामान्य रही और 3 प्रभागों में वर्षा कम रही ।

तापमान

देश के अधिकतर भागों में अधिकतम, न्यूनतम और औसत तापमान की विसंगति -0.5 डि. सें. से + 1.0 डि. सें. की श्रेणी में रही । मगर देश के उत्तर, उत्तर-पूर्व और दक्षिण प्रायद्वीप के कुछ भागो में, अंदमान और निकोबार द्वीपसमुह मे औसत तापमान 1 डि. सें. से अधिक रहा ।

चक्रवाती तूफान

2019 मे बंगाल की खाडी मे तीन चक्रवाती तूफान हुए । यह चक्रवाती तूफान जनवरी, एप्रिल, नवंबर में प्रतिमाह एक हुए । इनके अलावा अरबी समुद्र में मानसून ऋतु में दो तीव्र चक्रवाती तूफान और मानसूनोत्तर में तीन (दो तीव्र) चक्रवाती तूफान हुए । मानसून ऋतु में 14 कम दबाव के क्षेत्र बने (2 बहुत तीव्र चक्रवाती तूफान, 1 अति तीव्र कम दबाव क्षेत्र, 4 तीव्र कम दबाव क्षेत्र, 2 अच्छी तरह से चिन्हित कम दबाव क्षेत्र और 2 कम दबाव के क्षेत्र) । इन सभी कम दबाव की प्रणालियों की वजह से संबन्धित स्थानों मे अच्छी वर्षा हुई ।

महत्वपूर्ण मौसम संबंधी घटनाएं

भारी वर्षा और बाढ संबंधी घटनाओं से करीब 850 से ज्यादा लोगों की मृत्यु की सूचना प्राप्त हुई । ऊष्ण लहर कि चपेट में 350 लोगों की मृत्यु की सूचना प्राप्त हुई । आकाशीय बिजली से 380 लोगों की मृत्यु की सूचना (मानसून पूर्व, मानसून और मानसूनोत्तर ऋतुओं में), देश के विभिन्न भागों से प्राप्त हुई । इनमे से 125 झारखड से, 73 बिहार से, 51 महाराष्ट्र से, राजस्थान और मध्य प्रदेश प्रत्येकी 24 लोगों की मृत्यु की सूचना प्राप्त हुई । शीत लहर कि चपेट में 70 लोगों की मृत्यु की सूचना प्राप्त हुई । हिमताप की वजह से जम्मु कश्मीर मे 33 लोगों की मृत्यु की सूचना मिली ।

HIGHLIGHTS
ANNUAL CLIMATE SUMMARY 2019

HIGHLIGHTS

Climate over India during 2019 was above average with respect to temperature. The annual mean temperature for the country this year was +0.36°C above the 1981-2010 average, thus making the year 2019 as the seventh warmest year on record since the nation-wide records commenced in 1901. Higher mean temperatures during the pre monsoon season (Mar-May, with anomaly 0.39°C and monsoon season (Jun-Sep, with anomaly 0.58°C, warmest since 1901) mainly accounted for the above normal annual temperature for the year.

Rainfall during the principal rainy season [Southwest (summer) monsoon season (June-September)] for the country as a whole was normal [110 % of Long Period average (LPA)]. The seasonal rainfall during the Northeast monsoon season (October – December) over the NE Monsoon core region of the south peninsula was 109% of its LPA.

The Northeast monsoon rainfall activity, over the south peninsula (core region of northeast monsoon rainfall activity comprising of 5 subdivisions viz. Coastal Andhra Pradesh & Yanam, Rayalaseema, Tamil Nadu, Puducherry & Karaikal, South Interior Karnataka and Kerala & Mahe) was normal (109 % of Long Period Average (LPA)).

During 2019, 8 cyclonic storms formed over the Indian seas. Arabian Sea contributed 5 out of these 8 cyclones against the normal of 1 per year, which equals the previous record of 1902 for the highest frequency of cyclones over the Arabian Sea. This year also witnessed development of more intense cyclones over the Arabian Sea.

TEMPERATURE

A) All India:

Annual:

Spatial pattern of annual mean, maximum and minimum temperature anomalies for 2019 are shown in Fig.1. Anomaly in the maximum, minimum and mean temperature over many parts of the country was generally in the range of ± 1.0°C. Mean temperature over parts of Jammu & Kashmir, Himachal Pradesh, Assam and Meghalaya, Telangana, north Interior Karnataka, Tamil Nadu, Puducherry & Karaikal, Kerala and Mahe and Andaman & Nicobar Islands was above normal by about 1°C. Max temperature over parts of Jammu & Kashmir, Himachal Pradesh, Assam and Meghalaya, Tamil Nadu, Puducherry & Karaikal, Kerala and Mahe was above normal by about 1°C. However, Max temperature over parts of Punjab, Haryana Chandigarh& Delhi, West Rajasthan was below normal by about 1°C.

The annual mean temperature for the country was +0.36°C above the 1981-2010 average, thus making the year 2019 as the seventh warmest year on record since 1901 (Fig. 2A). The other 9 warmest years on record in order were: 2016 (anomaly +0.71°C), 2009 (0.55°C), 2017 (0.54°C), 2010 (0.539°C), 2015 (0.42°C), 2018 (0.40°C), 1958 (0.25°C), 2002 (0.246°C) and 2014 (0.24°C). It may be mentioned that 11 out of the 15 warmest years were from the recent past fifteen years (2005-2019). In addition, the past decade (2001-2010/ 2010-2019) was the warmest decade on record with anomalies of 0.23°C / 0.36°C above average. During 1901-2019, the annual mean temperature showed an increasing trend of 0.61°C/100 years with significant increasing trend in the maximum temperature (1.0°C /100 years), and relatively lower increasing trend (0.22°C/100 years) in the minimum temperature.

Time series and trend in mean temperature anomalies for different seasons viz. winter (Jan to Feb), pre-monsoon (Mar to May), monsoon (June to Sept) and post-monsoon (Oct to Dec) seasons for the period 1901-2019 are shown in Figs 2B, 2C, 2D and 2E respectively. The mean temperature for the winter season (with anomaly +0.06°C) was above normal. The mean temperature was below normal during January (-0.03°C) and above normal during February (0.15°C)

The pre-monsoon season (March-May) this year was also warmer. The season this year (with anomaly +0.39°C above average) was the fourteenth warmest since 1901. The mean temperature was below normal during March (-0.14°C) and above normal during April (+0.77°C) and May (+0.53°C). April was the seventh warmest since 1901.

Monsoon season this year (with anomaly +0.58°C above average) was the warmest since 1901. The mean temperature was above normal during June (1.02°C), July (0.68°C), August (0.37°C) and September (0.25°C). July was warmest while June was fourth warmest since 1901 after the years 1958(1.093^0C), 2014(1.092^0C) and 1926(1.07^0C), August was sixth warmest and September was eighth warmest since 1901.

The Post-monsoon season this year (with anomaly +0.25°C above average) was the sixteenth warmest since 1901. The mean temperature was above normal during October (0.19°C), November (0.72°C) and below normal during December (-0.17°C). November was the third warmest since 1901 after the years 2015 (0.869^0C), 1979 (0.867^0C)

Spatial pattern of trend in mean annual temperature anomalies based on the data for the period 1901-2019 (Fig.3) suggests significant positive (increasing) trend over most parts of the country except for some parts of Bihar, Gujarat and adjoining southern parts of Rajasthan, East Uttar Pradesh where significant negative (decreasing) trend was observed.

A) Spatial pattern:

Fig.4 shows the spatial pattern of monthly maximum and minimum temperature anomalies. Regions with significant temperature anomaly (> or < ± 2°C) during each concerned month are discussed below.

January-February (winter season):

During January, maximum temperature was above normal by about 2 to 3°C, over parts of northeast India and was below normal by about 2°C, over parts of Gangetic West Bengal and Jammu and Kashmir. Minimum temperature was below normal by about 2°C, over parts of Marathwada, Vidarbha, Madhya Pradesh, Chhattisgarh, Odisha and Lakshadweep islands. Magnitude of minimum temperature anomaly was less than 3°C over parts of Madhya Pradesh and Vidarbha.

During February, Maximum temperature was below normal over parts of Jammu & Kashmir, west Rajasthan and Uttar Pradesh and Uttarakhand by about 2°C.

March- May (Pre-monsoon season):

During March, maximum temperature was below normal by about 2°C over parts of west Rajasthan, Haryana, Chandigarh & Delhi, west Madhya Pradesh and Gangetic West Bengal and Andaman & Nicobar Islands. Minimum temperature anomaly was less than -2°C over parts of Haryana, Chandigarh & Delhi, east Rajasthan and Gangetic West Bengal

During April, Maximum temperature anomaly was more than 2°C over parts of Arunachal Pradesh, Assam & Meghalaya, Jammu & Kashmir, Himachal Pradesh, Marathwada, Vidarbha, Kerala and Mahe, Nagaland and Saurashtra & Kutch. Maximum temperature anomaly was less than -2°C over parts of Gangetic West Bengal, Jharkhand, Bihar and Andaman & Nicobar Islands. Minimum temperature was above normal by about 2°C, over parts of Rajasthan, Gujarat Region, east Rajasthan, Punjab, Madhya Maharashtra, Vidarbha and Telangana.

During May, Maximum temperature anomaly was more than 2°C over parts of east Uttar Pradesh, Bihar, Madhya Maharashtra, Marathwada, Vidarbha, Telangana, Tamil Nadu & Puducherry & Karaikal, North Interior Karnataka and Kerala & Mahe. Maximum temperature anomaly was less than 2°C in Arunachal Pradesh and in parts of Assam & Meghalaya, Nagaland and Andaman & Nicobar Islands. Minimum temperature was above normal by about 2°C, over parts of Vidarbha, Marathwada, north interior Karnataka and Telangana while it was below normal by about 2 to 3°C, over parts of Punjab, Haryana,

June-September (Monsoon season):

During June, Maximum temperature anomaly was more than 2 to 3°C over parts of Jharkhand, Bihar, east Uttar Pradesh, Gangetic West Bengal, Odisha, Chhattisgarh, Marathwada, Vidarbha, Madhya Pradesh, Uttarakhand, Himachal Pradesh, west Rajasthan, Tamil Nadu & Puducherry, coastal Andhra Pradesh, Rayalaseema and Kerala. It was more than 3°C over parts of Vidarbha, Madhya Pradesh, Jharkhand and Bihar. Minimum temperature anomaly was more than 2°C in parts of Bihar, east Madhya Pradesh, Madhya Maharashtra, Vidarbha, Gangetic West Bengal, and Telangana.

During July, maximum temperature anomaly was more than 2°C over parts of Gujarat Region, Saurashtra & Kutch and west Rajasthan. During August, maximum temperature anomaly was more than 2°C over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Himachal Pradesh and Jammu & Kashmir

During September, maximum temperature anomaly was 2°C or more over parts of Jammu & Kashmir. Maximum temperature anomaly was 2°C or less, in parts of west Madhya Pradesh and Andaman & Nicobar Islands. Minimum temperature anomaly was more than 2°C over parts of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Rajasthan and East Madhya Pradesh.

During July and August minimum temperature anomaly was generally within ± 1°C range.

October-December (Post-monsoon season):

During October, maximum temperature anomaly was less than -2.0°C over parts of Madhya Maharashtra, Marathwada, Vidarbha, Madhya Pradesh state, east Rajasthan, Gangetic West Bengal and Gujarat Region. Minimum temperature anomaly was within ±1°C.

During November, maximum temperature anomaly was less than -2°C over parts of Jammu & Kashmir, west Rajasthan and Punjab, isolated places of Saurashtra & Kutch and Madhya Maharashtra. Maximum temperature anomaly was less than -3°C to -4°C over parts of Jammu & Kashmir and west Rajasthan. Maximum temperature anomaly was less than -5°C over parts of Jammu & Kashmir. Minimum temperature anomaly was greater than 2°C over parts of northeastern, northwestern and west central parts of India. Minimum temperature anomaly was greater than 3°C over parts of Rajasthan state, Punjab, Gujarat Region, Madhya Maharashtra and west Madhya Pradesh. Minimum temperature anomaly was greater than 4°C over parts of Gujarat Region and east Rajasthan.

During December, Maximum temperature anomaly less than 2°C was observed over northern regions of country. Maximum temperature anomaly less than 4°C was observed over parts of Punjab, Haryana, Chandigarh & Delhi, Uttar Pradesh, Bihar, Madhya Pradesh and west Rajasthan. Maximum temperature anomaly less than 5°C was observed over parts of Punjab, Haryana, Chandigarh & Delhi, west Rajasthan, Uttar Pradesh. Minimum temperature anomaly was above normal by 2°C or more, was observed over most parts of Maharashtra and some parts of Gujarat Region, west Madhya Pradesh, Andhra Pradesh & Yanam, Telangana, Chhattisgarh, Tamil Nadu, Puducherry & Karaikal. Minimum temperature anomaly was less than -2°C over parts of east Uttar Pradesh, west Madhya Pradesh and Jammu & Kashmir.

Fig.5 (a, b) shows the monthly minimum and maximum temperature anomaly for the country as a whole during past five years, 2015-2019 respectively. In respect of maximum temperature, the month of June was the warmest in the last five years, while June, July, September, November and December were warmest in respect of minimum temperature during the last five years.

Cold Wave conditions:

Severe Cold wave/cold wave conditions prevailed on a few days in the month of January, February and December over north, central, east and north peninsular India. Cold day to severe cold day conditions also prevailed on a few days over many parts of the country during these months.

Cold wave conditions prevailed on few days over isolated parts of central and northwest India in the first fortnight of January. During 29 Jan.-3 Feb., its intensity and spatial extent increased and these conditions were also observed over parts of Odisha during 30 Jan – 2 Feb. Also, during this period, cold day to severe cold day conditions were present over some parts of these regions.

During 9-10 Feb., cold day conditions prevailed over some parts in Bihar, Gujarat State, Rajasthan, Madhya Pradesh and Maharashtra and cold wave conditions prevailed on isolated days over some parts of east Rajasthan, Gangetic West Bengal, Odisha, Madhya Pradesh, Gujarat State, Maharashtra, and Chhattisgarh during 10-12 Feb.

During 16-18 Dec. and 22-31 Dec., cold day to severe cold day conditions prevailed over many parts of north and some parts of east India and central India. Severe cold to cold wave conditions prevailed on many days over north, northwest, east and central India during 26-31 Dec.

Fig 14 a, b show the minimum temperature anomaly diagrams for the duration when cold wave condition was at its peak.

Heat Wave Conditions:

Severe Heat Wave/Heat wave conditions prevailed over parts of central and northwest India during April, parts of central, east and peninsular India in the month of May. During June, many parts of the country reeled under heat wave except for northeast & western parts of peninsular India and extreme north India.

Heat wave conditions prevailed over some parts of Gujarat State from 25 March –4 April. These conditions also prevailed from 30 March to 15 April, in some parts, on most of the days over Rajasthan & Madhya Pradesh, and on isolated days over Madhya Maharashtra, Marathwada, Vidarbha, Chhattisgarh, east Uttar Pradesh and Haryana, Chandigarh & Delhi. The heat wave conditions were not observed over the entire country during the period 16 April—24 April. It then re-emerged from 25th April in some parts of central India and east Uttar Pradesh. Except for a brief period of 14 – 17 May where the heat wave was confined to Vidarbha, on the remaining days of the month, the condition was observed in southern India viz., Madhya Maharashtra, coastal Andhra Pradesh, Telangana, Tamil Nadu, Rayalaseema, on a few days, from 4th May and over Bihar in east India during 10-12 May. In the last week of the month, the severity and the spatial extent of the heat wave increased, when severe heat wave was observed over Vidarbha, west Rajasthan and east Uttar Pradesh and apart from central India, heat wave was also observed on isolated days over Telangana, north interior Karnataka and Haryana, Chandigarh & Delhi. The heat wave conditions were not observed over the entire country during 31 May to 9 June and 22 – 28 June. In the remaining days of the month of June, heat wave /severe heat wave conditions were observed on many days over some parts of the entire country except for northeast, extreme north and western parts of southern India.

In the month of July, heat wave conditions were observed only on isolated days over Rajasthan, Punjab, Delhi and Uttar Pradesh upto 4th July.

The heat wave conditions got abated from the entire country by 5 July. Fig 15a, b shows the maximum temperature anomaly diagrams for the duration when heat wave condition was at its peak.

RAINFALL

Time series of percentage departure of area weighted seasonal and annual rainfall over the country as a whole are shown in Fig. 6. In 2019, annual rainfall over the country as a whole was 110 % of its LPA value. Season wise rainfall distribution over the country as a whole is listed below:

Winter (January to February): 126% of LPA

Pre-monsoon (March to May): 78% of LPA

Monsoon (June to September): 110% of LPA

Post-monsoon (Oct to Dec): 130 % of LPA

Sub-division wise seasonal and annual rainfall statistics are given in Table 1 and spatial distribution is shown in Fig. 7. Month wise rainfall distribution is shown in Fig. 8.

Annual:

Rainfall activity over the country as a whole was above normal (110 % of LPA) during the year. Out of 36 meteorological subdivisions, two sub-division Saurashtra & Kutch and Madhya Maharashtra received large excess rainfall,10 received excess rainfall, 21 received normal rainfall and remaining 3 subdivisions received deficient rainfall.

At the end of year, of the four homogeneous regions, central India received 131%, south peninsular India received 109% and Northwest India received 106 % of their respective LPA rainfall. While, East & Northeast India received 88% of their respective LPA rainfall.

Winter season:

Rainfall realized during the season was 126% of LPA. It was 107% of LPA during January and was 141% of LPA during February.

During the season, out of 36 meteorological subdivisions, 6 received large excess rainfall, 7 received excess rainfall, 8 each received normal and deficient rainfall, 5 received large deficient rainfall and two subdivisions received no rain. The Islands, sub-divisions of northwest India and some subdivisions of south peninsula, central and east India received large excess/excess/normal rainfall. Table 1 shows the subdivision wise seasonal and annual rainfall statistics (mm) for the year 2019.

Pre-monsoon season:

Rainfall realized during the season was 78% of LPA. It was 62%, 80% and 83% of LPA during March, April and May respectively.

Rainfall activity during the season was rather subdued. During the season, out of 36 meteorological subdivisions, 3 received excess rainfall, 10 received normal rainfall, 14 received deficient rainfall and 9 received large deficient rainfall.

Monsoon season:

Rainfall realized during the season was 110% of LPA. It was 68%, 105%, 116 and 152% of LPA during June, July, August and September respectively.

Most sub-divisions of the country received large excess/excess/normal rainfall except a few from northern/northeastern regions. During the season, out of 36 meteorological subdivisions, 2 subdivisions received large excess rainfall, 10 subdivisions received excess rainfall, 21 received normal rainfall and the remaining 3 subdivisions received deficient rainfall. West Madhya Pradesh and Saurashtra & Kutch received large excess rainfall while Nagaland-Manipur-Mizoram-Imphal, west Uttar Pradesh and Haryana, Chandigarh & Delhi received deficient rainfall.

Daily area weighted rainfall (mm) over the country as a whole during the monsoon season 2019 (1st Jun. to 30th Sep.) and its long term average values are shown in Fig. 9. For the country as a whole, rainfall averaged was above or near normal on many days during the season. On almost 21 occasions, it was nearly one and half times its normal value. During 7^{th} -9^{th} August and 24^{th} - 30^{th} September, it was almost twice the normal at a stretch.

Post-monsoon season:

Rainfall realized over the country as a whole during the season was 130% of LPA. It was 145%, 104% and 111% of its LPA during October, November and December month respectively. Except Andaman & Nicobar Islands, Arunachal Pradesh, Sub-Himalayan West Bengal & Sikkim and Bihar all the remaining subdivisions received large excess/excess/normal rainfall.

Rainfall activity over core region of the south peninsula (comprising of 5 subdivisions viz. Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu & Puducherry, South Interior Karnataka and Kerala and Mahe) was above normal [109% of Long Period Average (LPA)]. It was above normal during October and December (142.8%of LPA, and 114.8% of LPA respectively) and was below normal during November (54.5%of LPA).

Out of 36 meteorological subdivisions, 13 subdivisions received large excess rainfall, 11 subdivisions received excess rainfall, 8 subdivisions received normal rainfall, 4 subdivisions received deficient rainfall. Time series of northeast monsoon seasonal rainfall over the south peninsula is shown in Fig 10.

Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is an index used for and is based on precipitation. This index is negative for dry, and positive for wet conditions. As the dry or wet conditions become more severe, the index becomes more negative or positive. Fig.11 gives the SPI values for the year 2019.

Cumulative SPI values of the past twelve months indicate, extremely wet/severely wet conditions over parts of Assam & Meghalaya, Punjab, Himachal Pradesh, Jammu & Kashmir, East Rajasthan, Madhya Pradesh State, Gujarat State, Konkan & Goa, Madhya Maharashtra, Vidarbha, Chhattisgarh, Telangana, Karnataka State and Lakshadweep while extremely dry/severely dry conditions were observed over parts of Assam & Meghalaya, Nagaland, Manipur, Mizoram & Tripura, Sub-Himalayan West Bengal & Sikkim, Gangetic West Bengal, Jharkhand, Uttar Pradesh state, Haryana, Chandigarh & Delhi, Jammu & Kashmir, Vidarbha and Chhattisgarh.

TROPICAL STORMS / DEPRESSIONS IN THE INDIAN SEAS

During 2019, eight cyclonic storms formed over the north Indian Ocean. Out of these 8 systems, one system each formed during the winter (Cyclonic Storm “Pabuk”) and pre-monsoon season (Extremely Severe cyclonic Storm (ESCS), “Fani”) over the Bay of Bengal. The ESCS “Fani” which formed during pre-monsoon season, crossed the Odisha coast near Puri on 3rd May and claimed over 64 lives from different districts of the state. The monsoon season too witnessed 2 very severe cyclonic storms (VSCS) “Vayu” and “Hikka” over Arabian Sea in the month of June and September respectively. Of these, the cyclonic storm “Vayu” dissipated before crossing Gujarat coast and the cyclonic storm “Hikka” moved away from the Indian region and crossed the Oman coast. During the post-monsoon season, 3 systems formed over the Arabian Sea and 1 system over the Bay of Bengal. The super cyclonic storm “Kyarr”, ESCS “Maha” and the CS “Pawan” did not have landfall over the Indian region. The VSCS “Bulbul” which formed over the Bay of Bengal, skirted the West Bengal coast close to Sunderbans forest on 9th November.

During 2019, 8 cyclonic storms formed over the Indian Seas against the normal of 5 cyclonic storms with Arabian sea alone contributing 5 cyclonic storms against a normal of 1 cyclone. Considering the past data (1891-2018), the highest number of cyclones formed in both the Indian Seas together was 10 during the four years (1893, 1926, 1930 and 1976).). In case of Arabian Sea, the 5 cyclones which formed during 2019 equals the previous record of 1902 for the highest frequency of cyclones. The year 2019 also witnessed development of more intense cyclones over the Arabian Sea. Out of 5 systems formed in the Arabian Sea, there have been two very severe cyclonic storms, one extremely severe cyclonic storm and one super cyclonic storm. However, the cyclone activity over the Bay of Bengal during 2019 has been found subdued as only 3 cyclones formed against the normal of 4 per year.

During winter season four low pressure areas formed, one over equatorial Indian Ocean and adjoining central Bay of Bengal during January and 3 over land in the month of February.

During pre-monsoon season apart from the above mentioned intense systems, one short lived low pressure area formed in month of May.

During the monsoon season, fourteen low pressure systems (2 very severe cyclonic storms, 1 Deep Depression, 1 Depressions, 3 well marked low pressure areas & 7 low pressure areas) were formed. The frequency and place of origin of these low pressure systems formed over the Indian region during the monsoon season is shown in the table below.

Systems/month	CS	DD	D	WML	LPA
June	1(AS)	0	0	0	1(BOB)
July	0	0	0	1(BOB), 1(LAND)	1(BOB), 1(LAND)
August	0	1(BOB)	0	1 (BOB)	1(LAND),2(BOB)
September	1(AS)	0	1(AS)	0	1(BOB)
(AS): Arabian Sea, (BOB): Bay of Bengal					

During monsoon season apart from the storms discussed above, 2 depressions formed. Out of this one deep depression formed in the month of August (6-9 Aug). It formed over northwest Bay of Bengal off north Odisha- West Bengal coast and dissipated over West Madhya Pradesh. This system caused fairly widespread to widespread rainfall along with very heavy rainfall over parts of central and peninsular India. The other depression formed during September (29 Sep - 1 Oct) over Kutch and neighbourhood and dissipated over southeast Rajasthan & neighbourhood.

During the post monsoon season, apart from the storm mentioned above two depressions formed in the month of December over Arabian Sea and two low pressure areas formed, one in month of October which became well marked and another during December. The tracks of these storms and depression formed during the year is shown in Fig 12(a) and Fig 12 (b)

Frequency of depressions and cyclonic storms formed over the north Indian Ocean and land (1951-2019) during the monsoon and other seasons is shown in Fig..13 (a) and 13(b).

SIGNIFICANT WEATHER EVENTS

Heavy rain & flood related incidents reportedly claimed over 850 lives from different parts of the country during the pre-monsoon, monsoon & post-monsoon seasons. Of these, 306 lives were reported from Bihar alone, 136 from Maharashtra, 107 from Uttar Pradesh, 88 from Kerala, 80 from Rajasthan and 43 from Karnataka.

Heat wave conditions which prevailed over the northeastern & central parts the country during the period March to June claimed about 350 lives. Of these, 293 lives were reported from the worst affected state of Bihar alone during June and 44 lives were reported from Maharashtra.

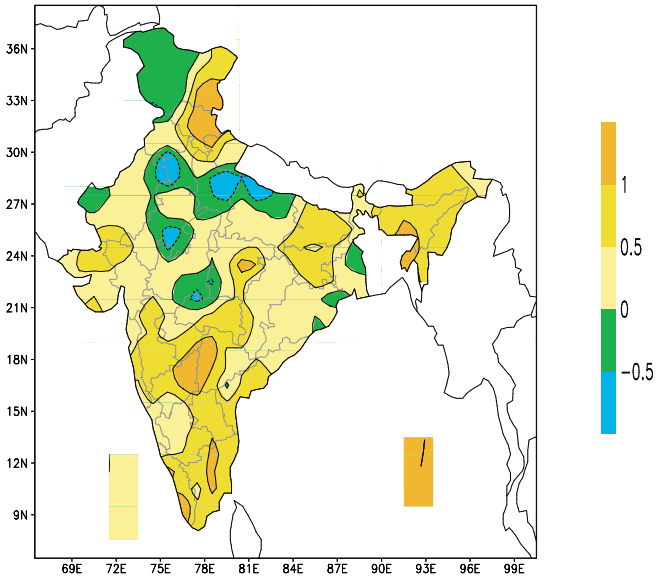
Lightning & Thunderstorm reportedly claimed over 380 lives from central, northeastern, northwestern and peninsular parts of the country during pre-monsoon, monsoon & post-monsoon seasons. Of these, 125 lives were reported from Jharkhand, 73 from Bihar, 51 from Maharashtra and 24 each from Madhya Pradesh & Rajasthan.

Snowfall and avalanche related incidents claimed 33 lives from Jammu & Kashmir & 18 from Leh.

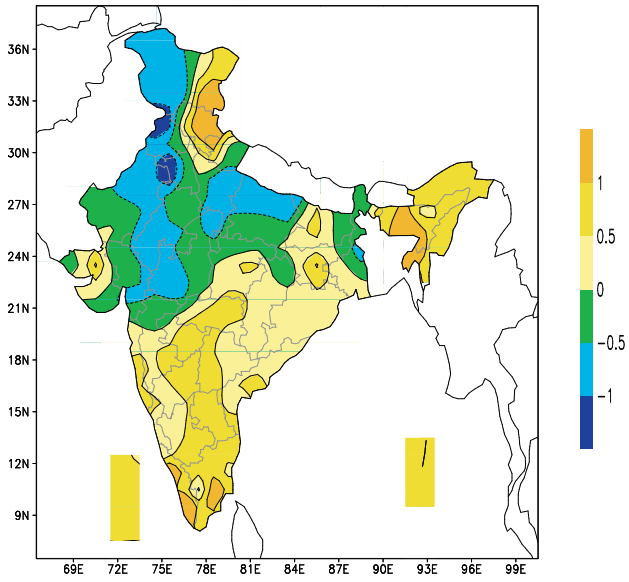
Cold wave claimed 70 persons from northern parts of the country during 15th to 31st December. Of these, 28 lives were reported from Uttar Pradesh, 19 from Bihar, 13 from Jharkhand & 10 from Madhya Pradesh.

Significant weather events during 2019 and associated loss of lives are shown in Fig.16.

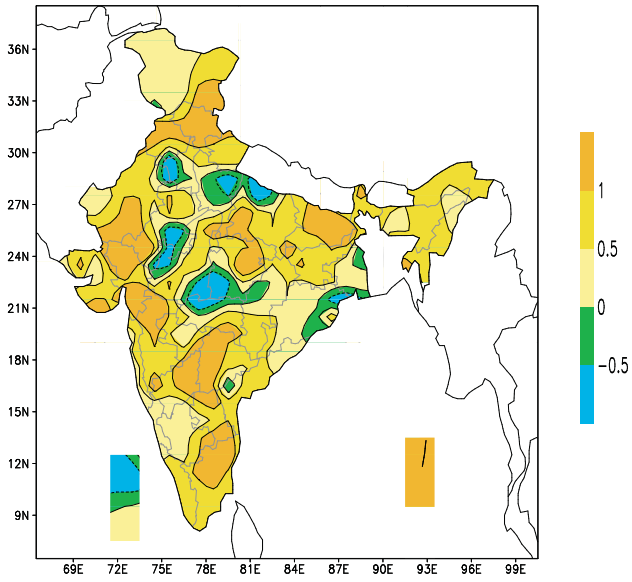
The highest maximum & lowest minimum temperature and highest rainfall in 24 hours recorded over a station during the year 2019 with the dates of occurrences are given in Table 2.



(a) MEAN



(b) MAXIMUM



(c) MINIMUM

FIG. 1 : ANNUAL TEMPERATURE ANOMALIES (°C) FOR 2019 WITH RESPECT TO 1981 - 2010 AVERAGE

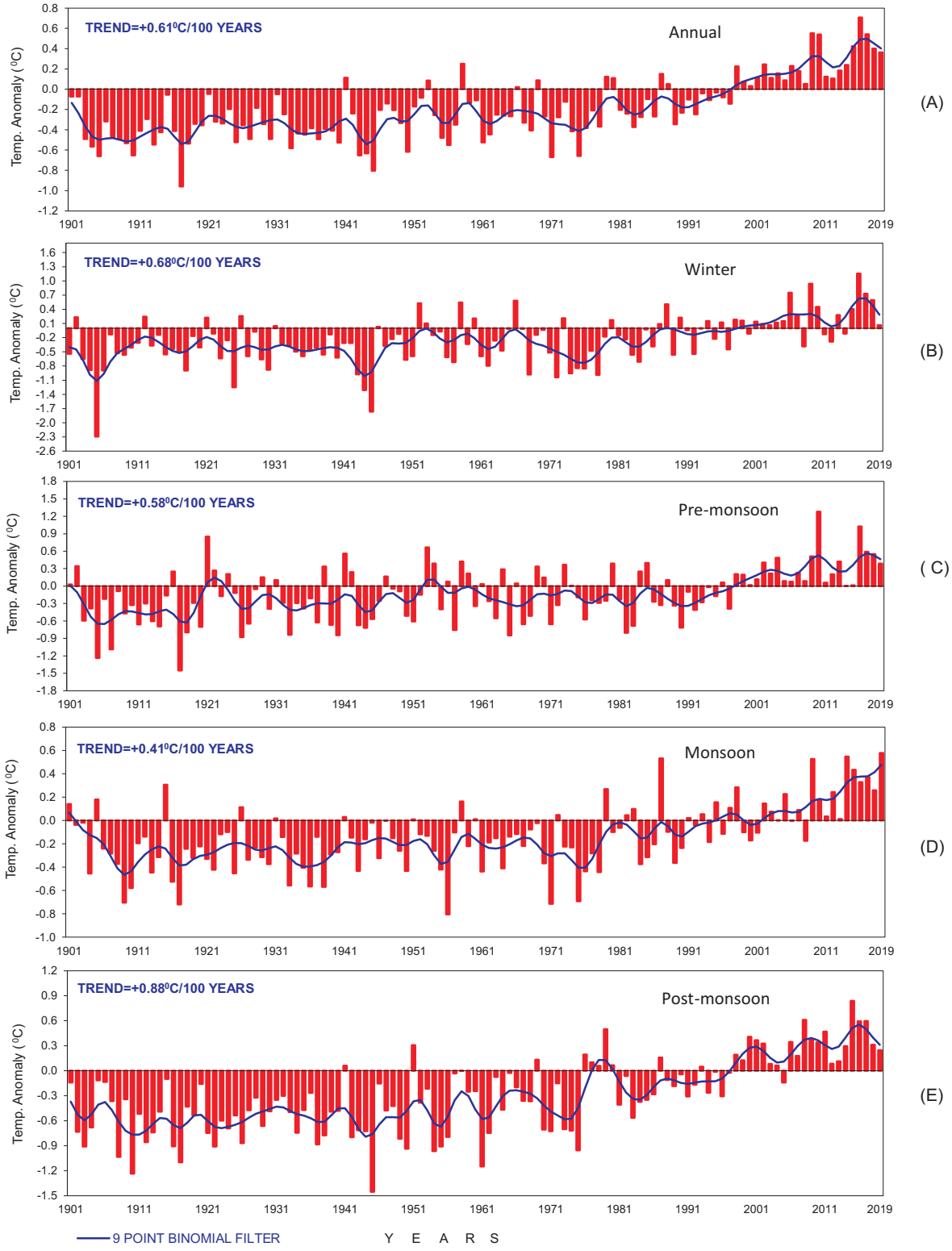


FIG. 2 : ALL INDIA MEAN TEMPERATURE ANOMALIES (A) ANNUAL, (B) WINTER, (C) PRE MONSOON, (D) MONSOON AND (E) POST MONSOON FOR THE PERIOD 1901 - 2019 SHOWN AS VERTICAL BARS. THE SOLID BLUE CURVE HAD SUB-DECADAL TIME SCALE VARIATIONS SMOOTHED WITH A BINOMIAL FILTER
(DEPARTURES FROM THE 1981 - 2010 AVERAGE)

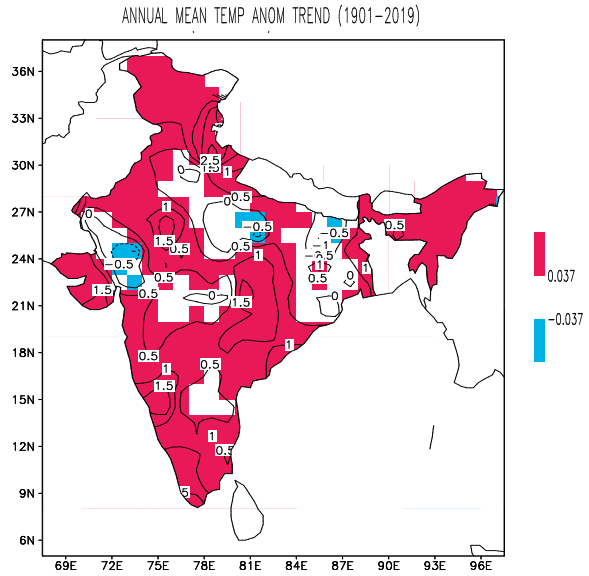


FIG. 3 : ANNUAL MEAN ANOMALY TEMPERATURE TRENDS (°C / 100 YEARS) ARE SHOWN AS CONTOUR LINES. THE TRENDS SIGNIFICANT AT 95% LEVEL ARE SHADED. POSITIVE TRENDS ARE SHOWN IN RED WHILE THE NEGATIVE TRENDS ARE SHOWN IN BLUE. PERIOD OF ANALYSIS : 1901 - 2019

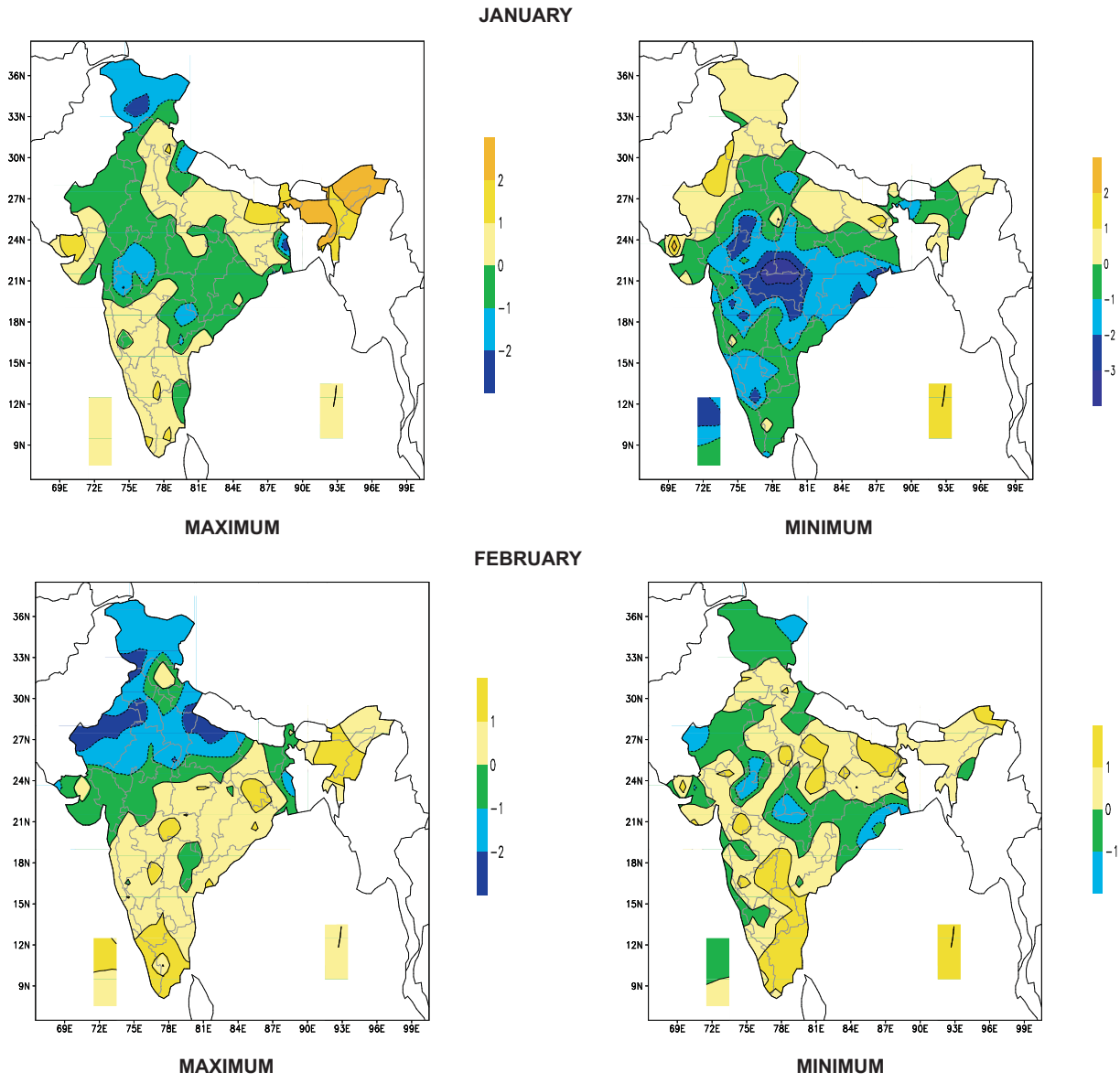
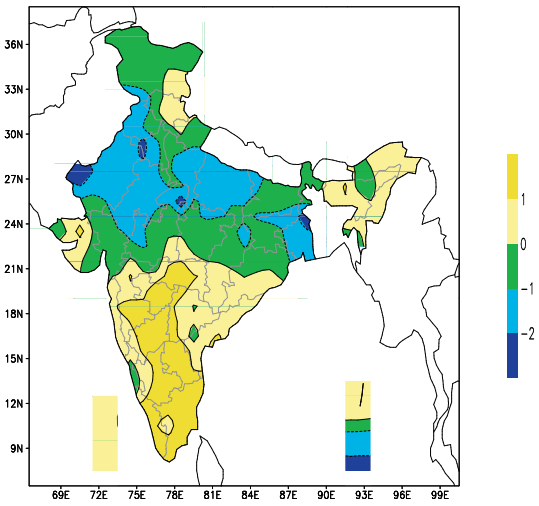
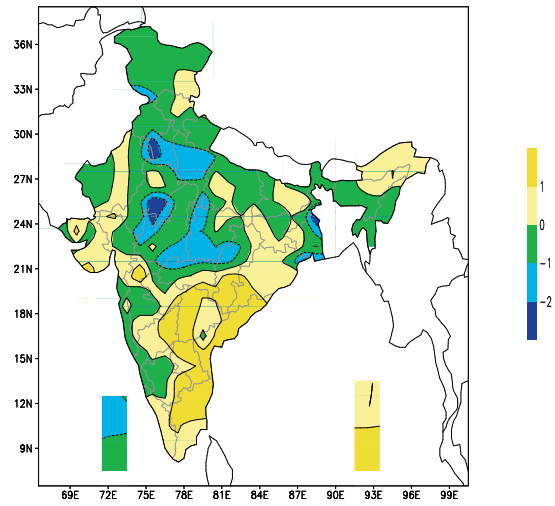


FIG. 4 : MONTHLY MEAN MAXIMUM AND MINIMUM TEMPERATURE ANOMALIES(°C) IN 2019 WITH RESPECT TO 1981 - 2010 AVERAGE

MARCH

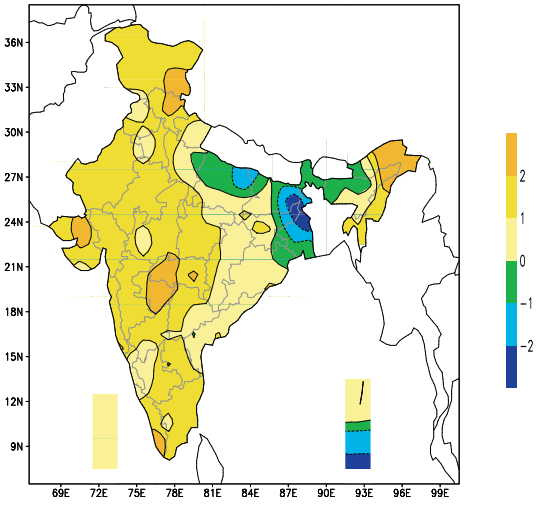


MAXIMUM

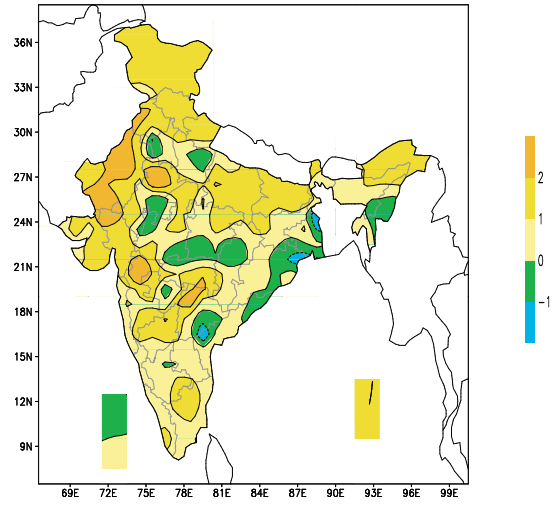


MINIMUM

APRIL

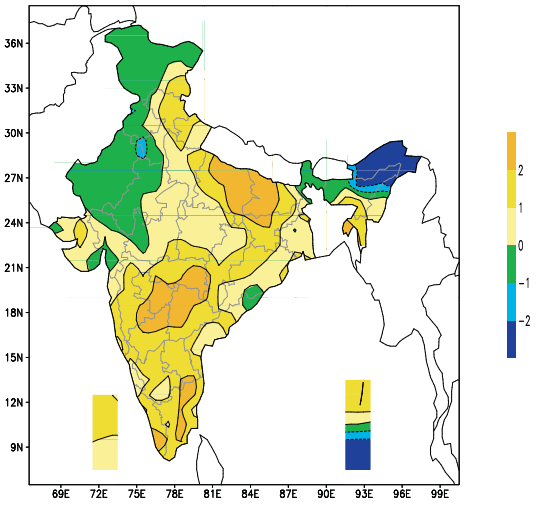


MAXIMUM

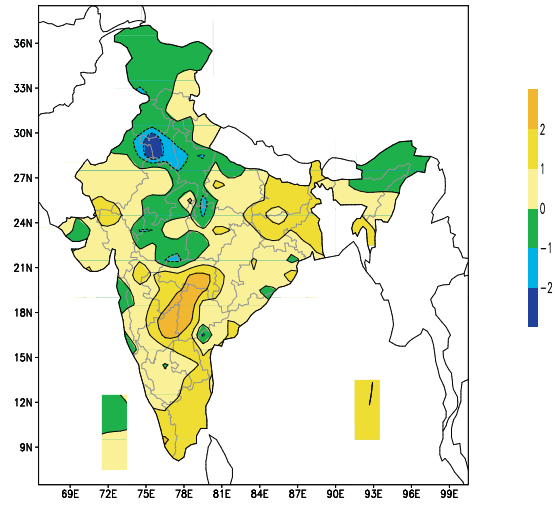


MINIMUM

MAY



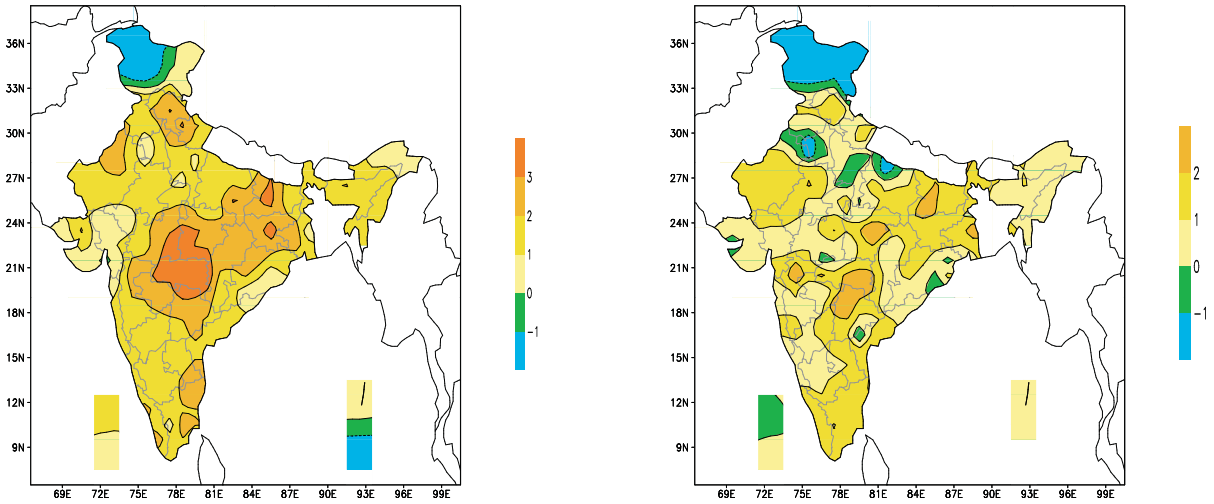
MAXIMUM



MINIMUM

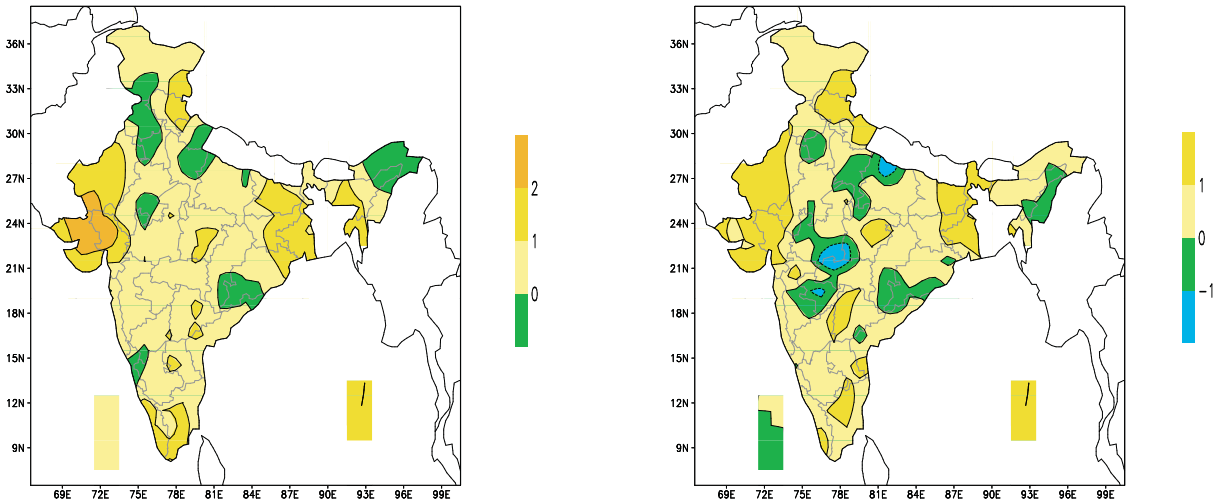
FIG. 4 : Contd...

JUNE



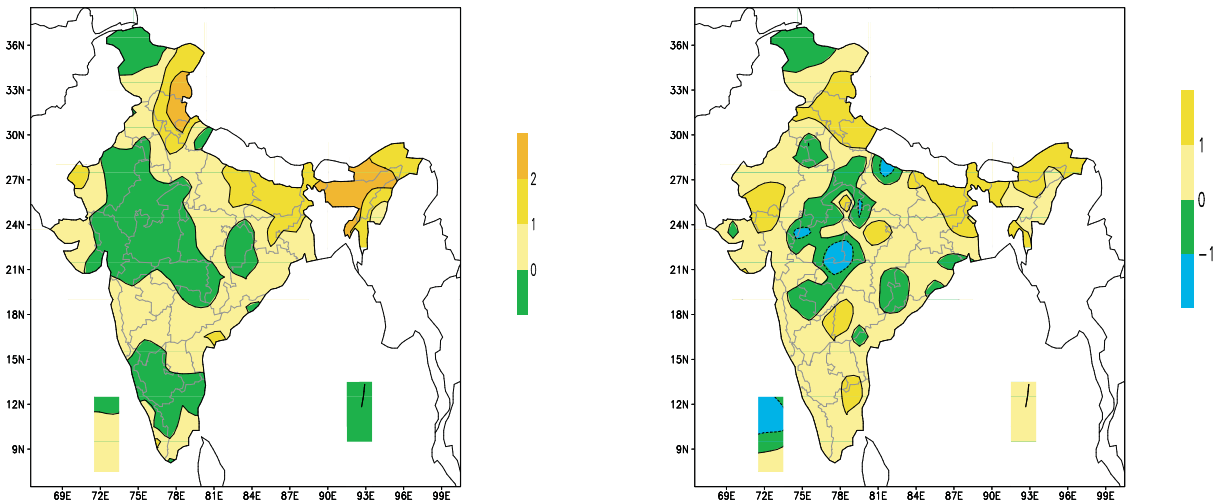
MAXIMUM **MINIMUM**

JULY



MAXIMUM **MINIMUM**

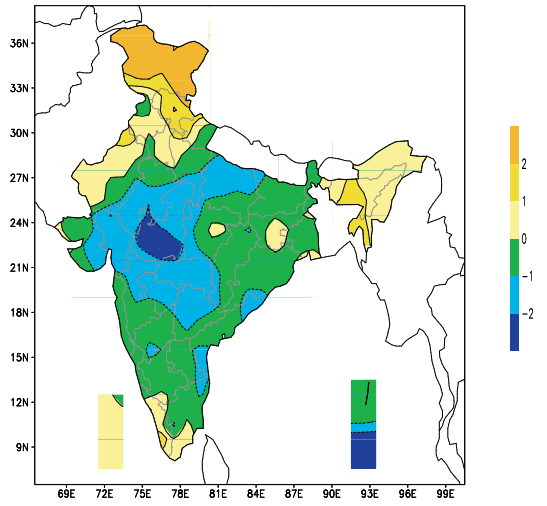
AUGUST



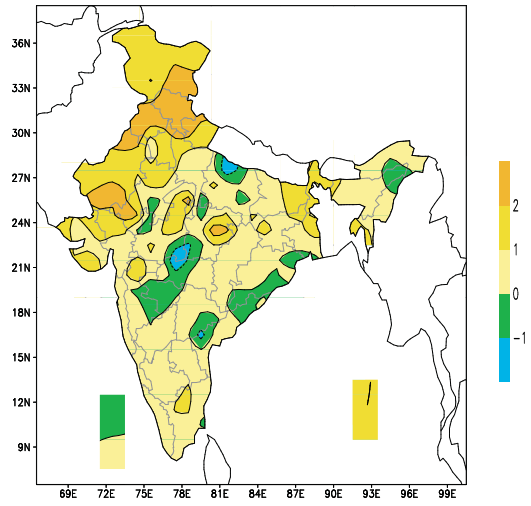
MAXIMUM **MINIMUM**

FIG. 4 : Contd..

SEPTEMBER

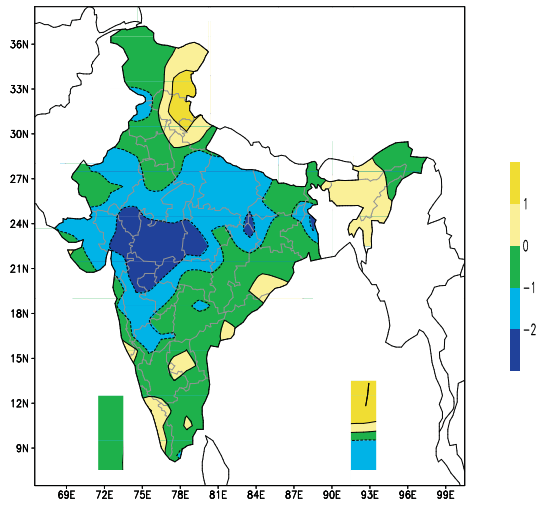


MAXIMUM

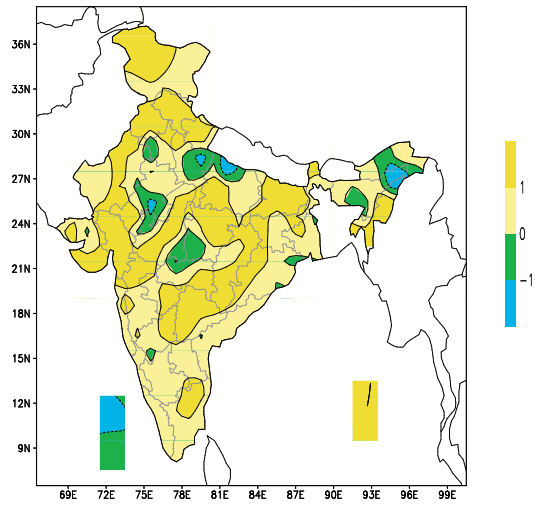


MINIMUM

OCTOBER

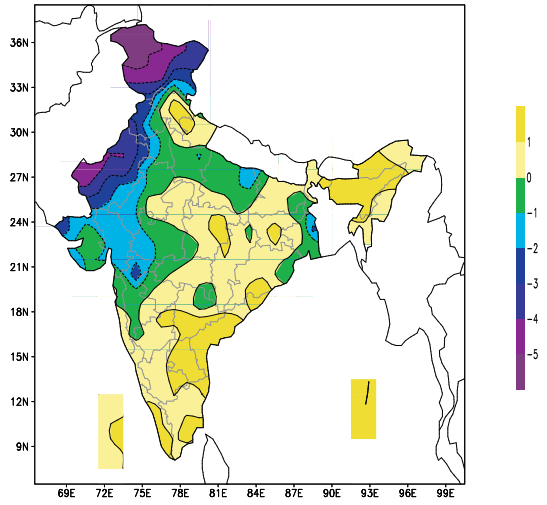


MAXIMUM

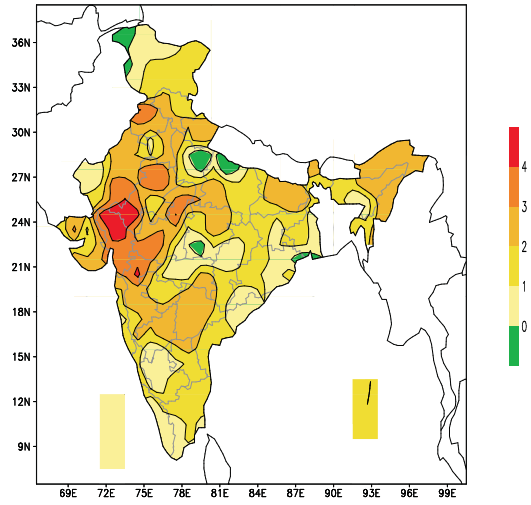


MINIMUM

NOVEMBER



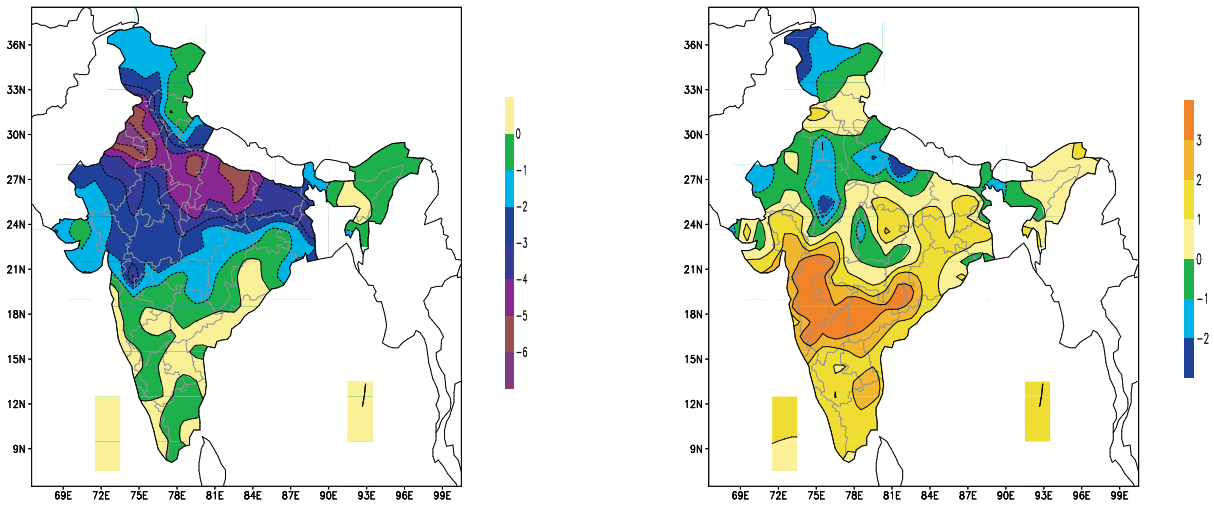
MAXIMUM



MINIMUM

FIG. 4 : Contd..

DECEMBER



MAXIMUM **MINIMUM**

FIG. 4 : Contd..

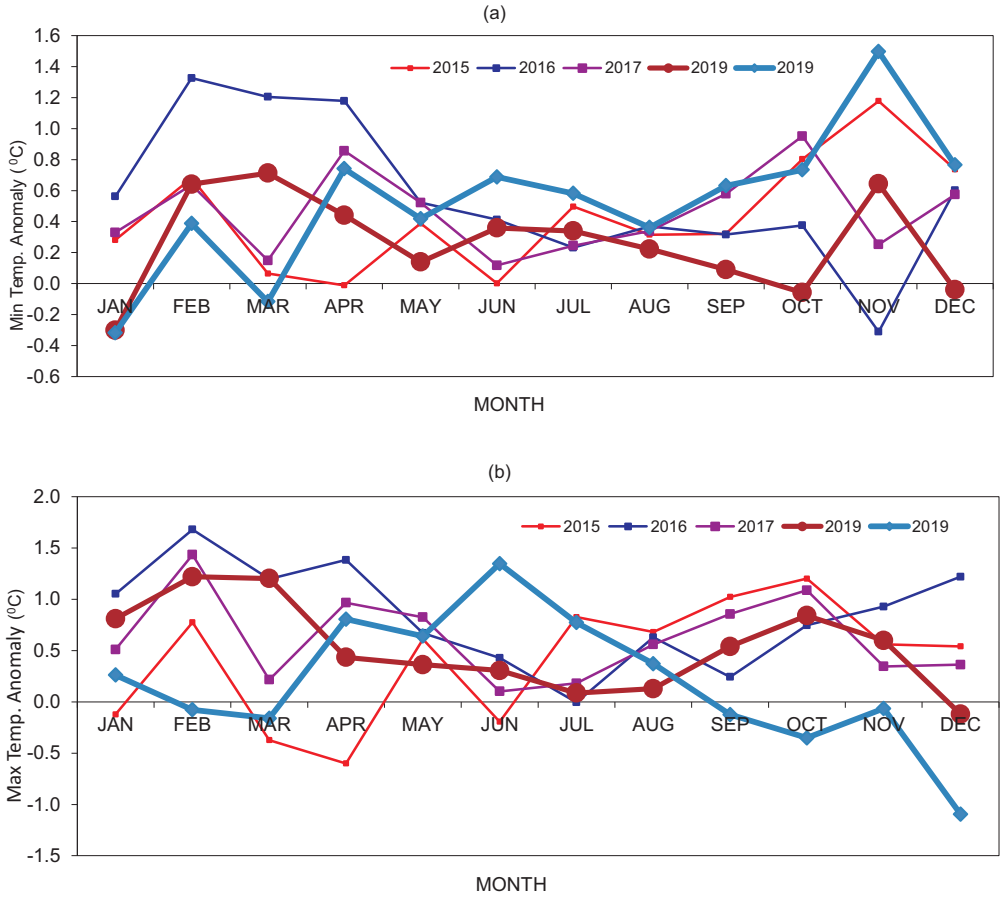


FIG. 5 : MEAN MONTHLY (a) MINIMUM AND (b) MAXIMUM TEMPERATURE ANOMALIES (2015 - 2019)

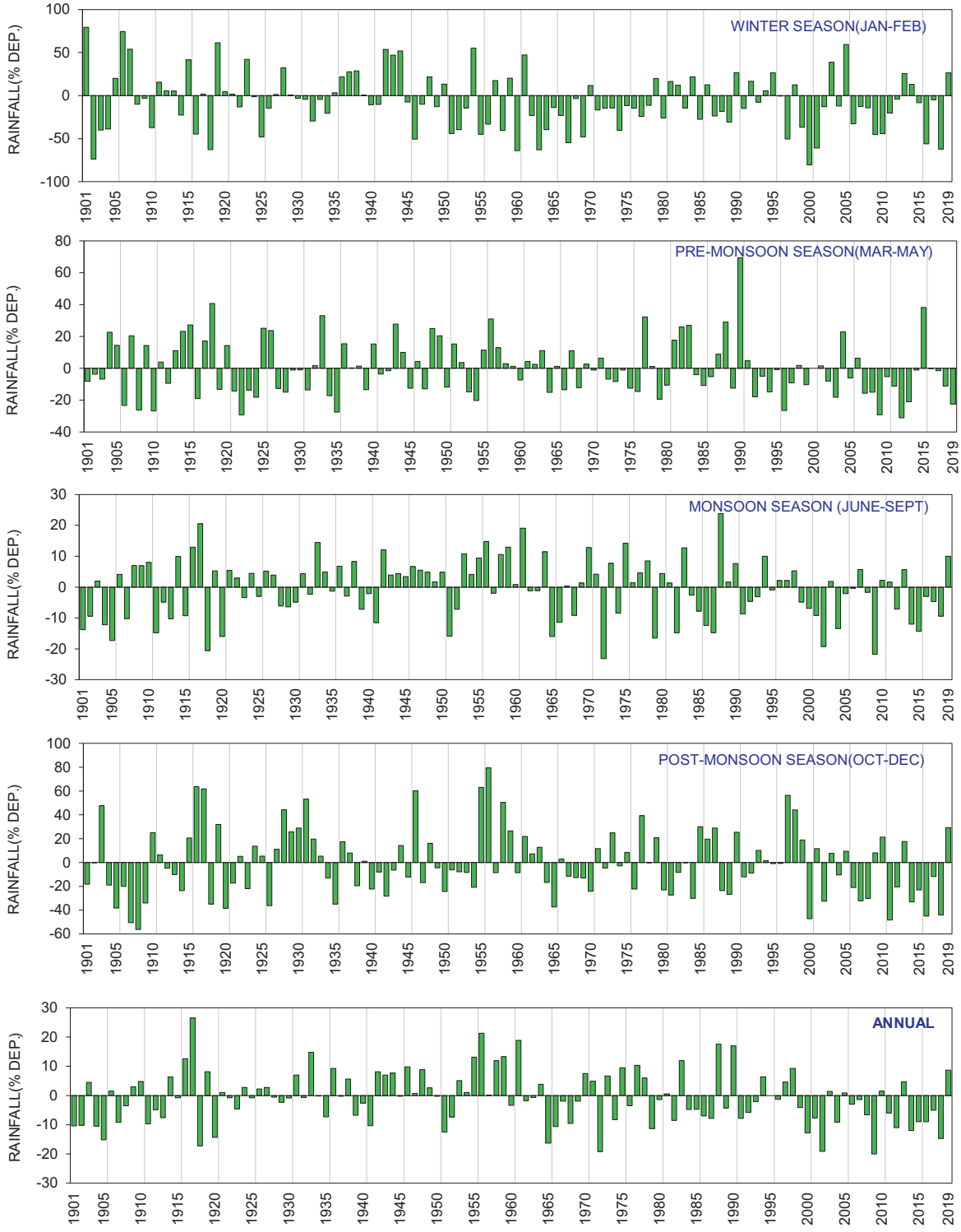
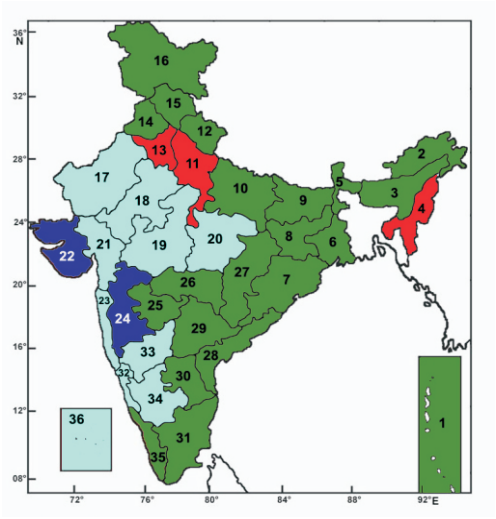
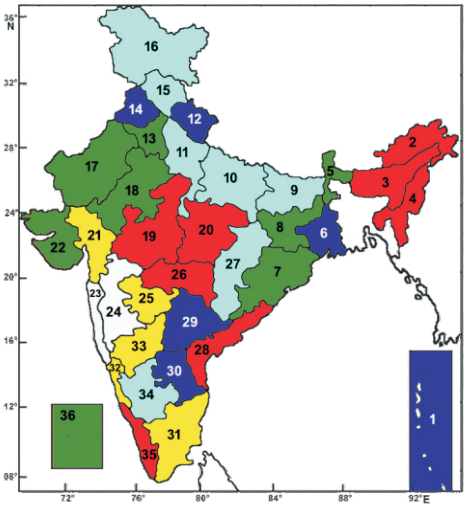


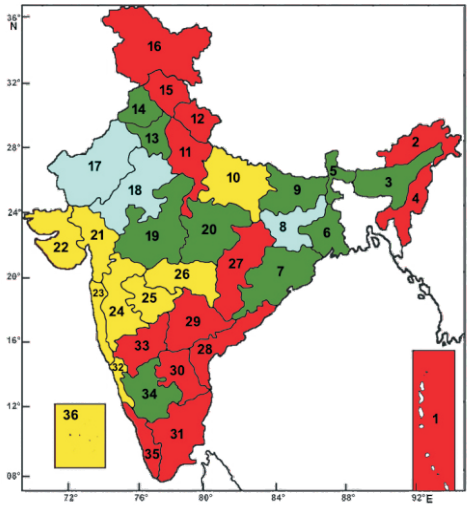
FIG. 6 : PERCENTAGE DEPARTURE OF AREA WEIGHTED SEASONAL AND ANNUAL RAINFALL OVER THE COUNTRY AS A WHOLE (1901-2019)



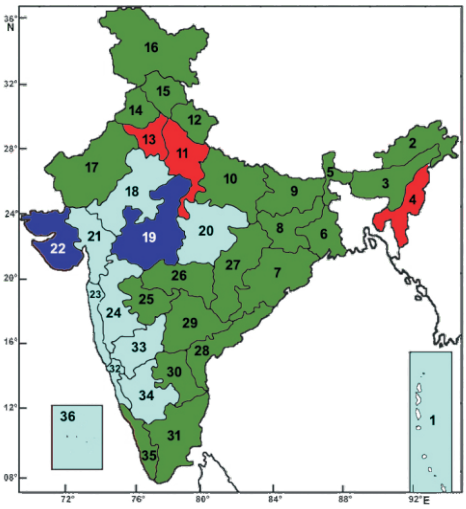
ANNUAL



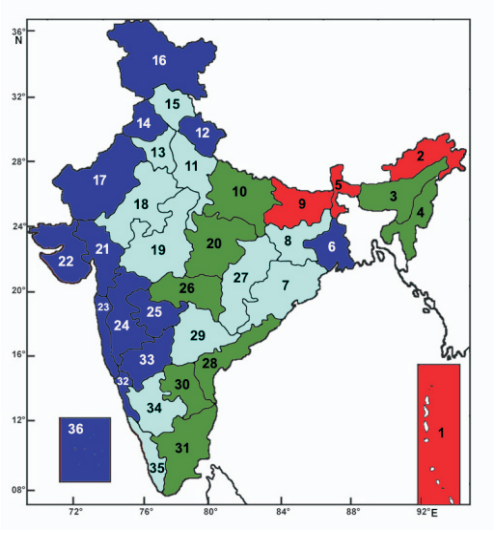
WINTER



PRE-MONSOON



MONSOON



POST-MONSOON

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%

(Figures indicates subdivision numbers)

FIG. 7 : SUB-DIVISIONWISE ANNUAL & SEASONAL RAINFALL PERCENTAGE DEPARTURES

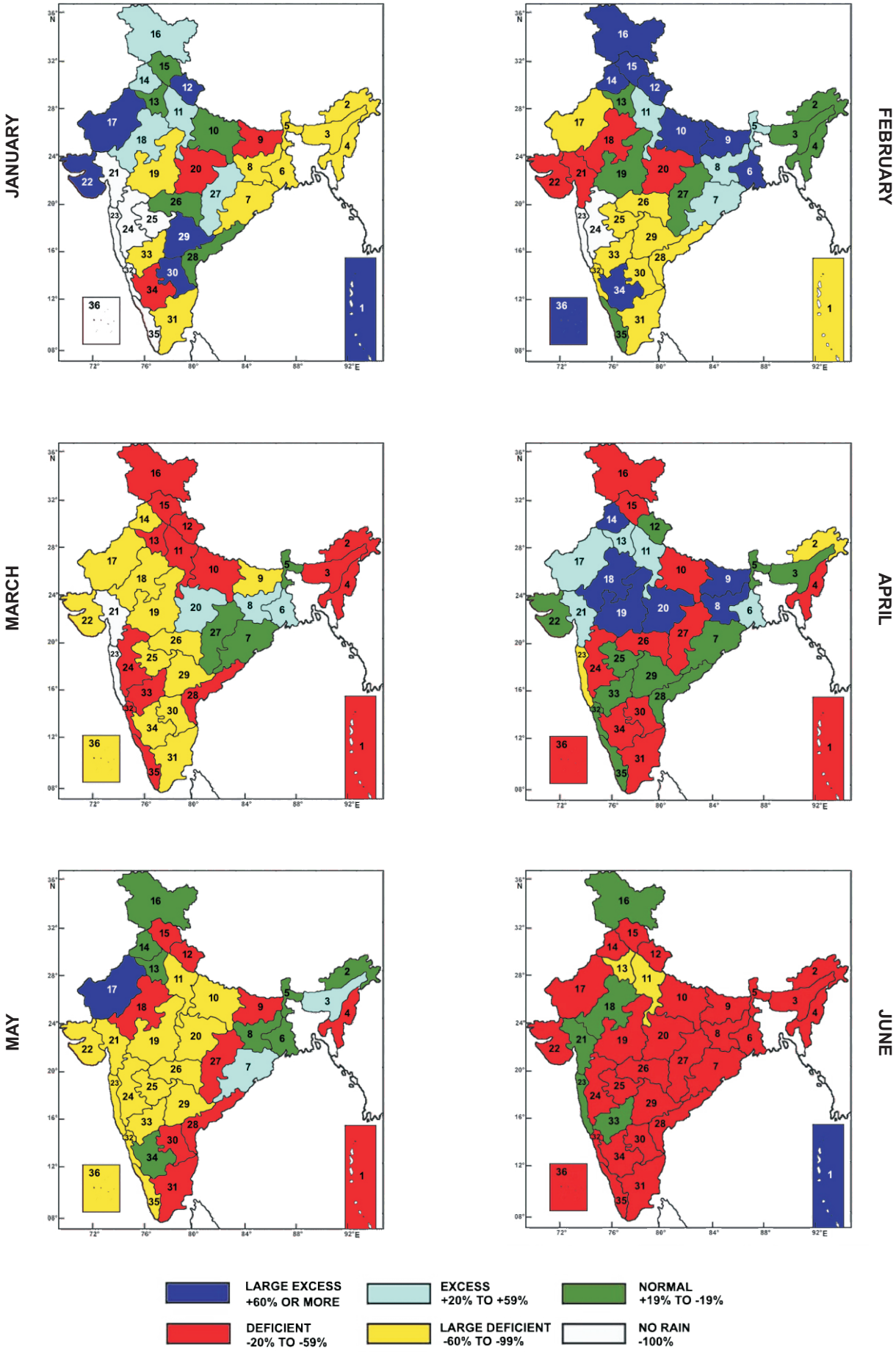


FIG.8 : SUB-DIVISIONWISE MONTHLY RAINFALL PERCENTAGE DEPARTURES FOR 2019

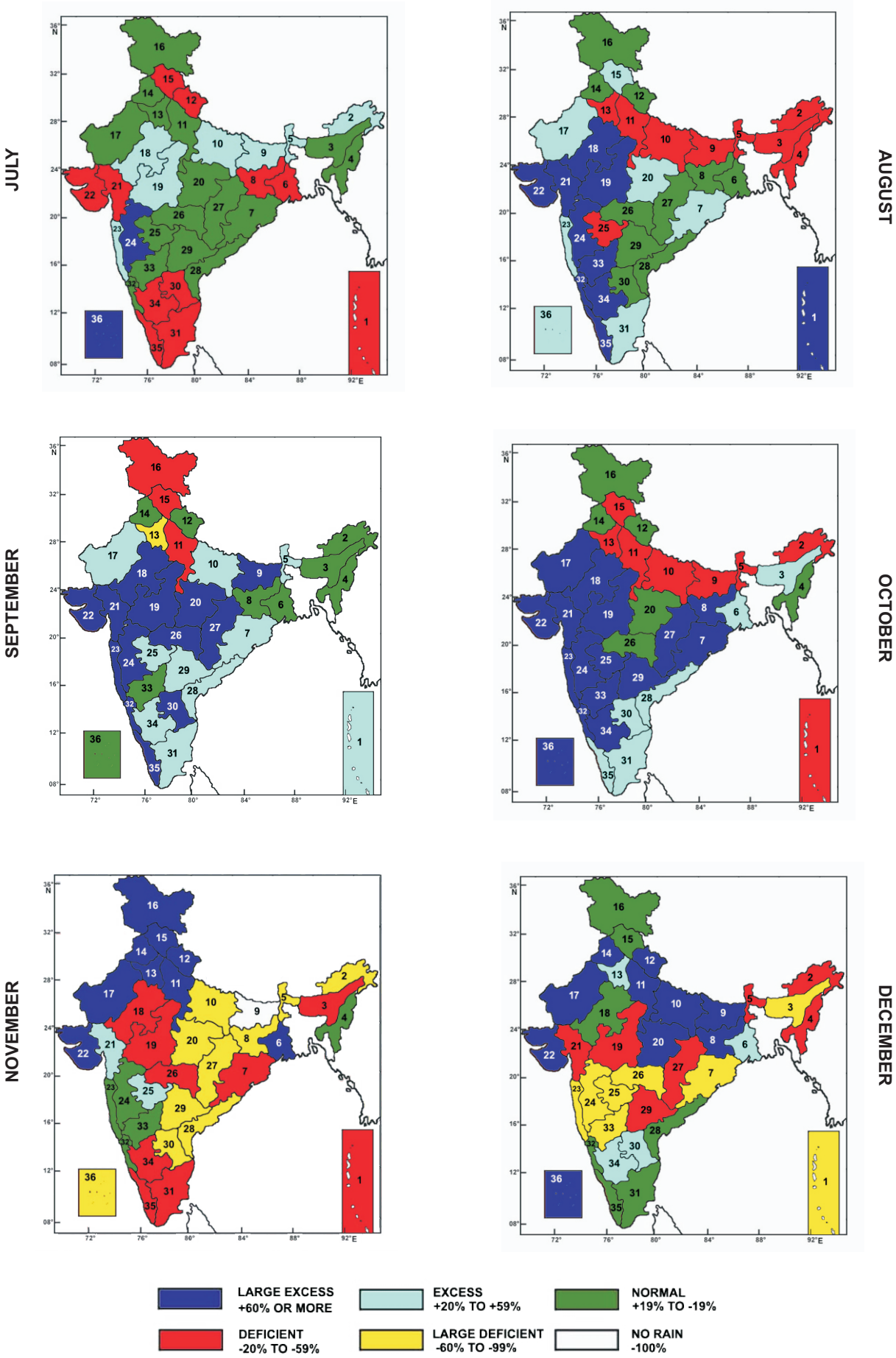

JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
LARGE EXCESS
+60% OR MORE
EXCESS
+20% TO +59%
NORMAL
+19% TO -19%
DEFICIENT
-20% TO -59%
LARGE DEFICIENT
-60% TO -99%
NO RAIN
-100%

FIG.8 : Contd.....

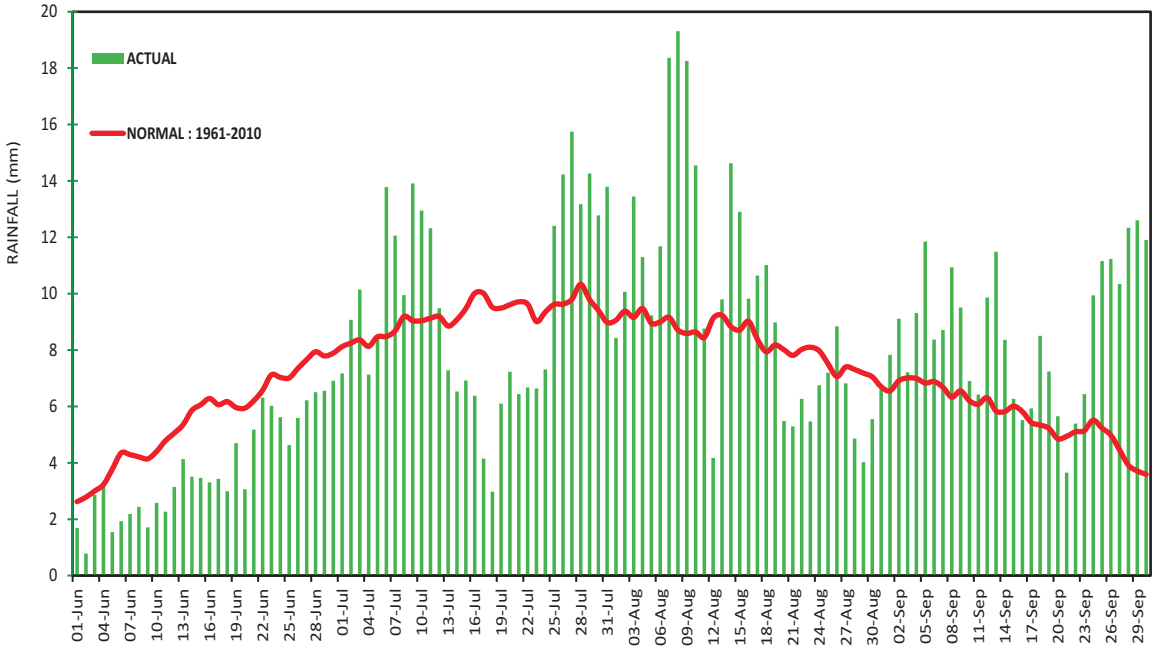


FIG. 9 : DAILY AREA WEIGHTED RAINFALL (mm) OVER THE COUNTRY AS A WHOLE (VERTICAL BARS) AND ITS LONG TERM AVERAGE (1951-2000) (CONTINUOUS LINE) 1 JUNE - 30 SEPTEMBER 2019

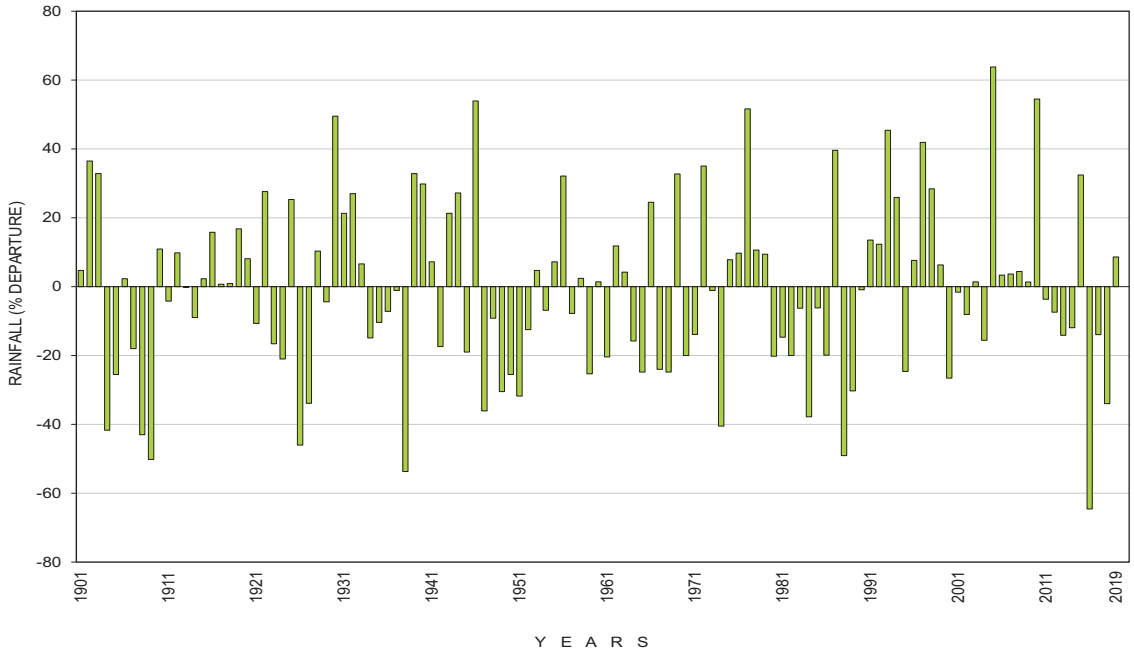


FIG. 10 : PERCENTAGE DEPARTURE OF RAINFALL DURING THE POST-MONSOON SEASON (OCTOBER TO DECEMBER) OVER THE SOUTH PENINSULA (1901-2019)

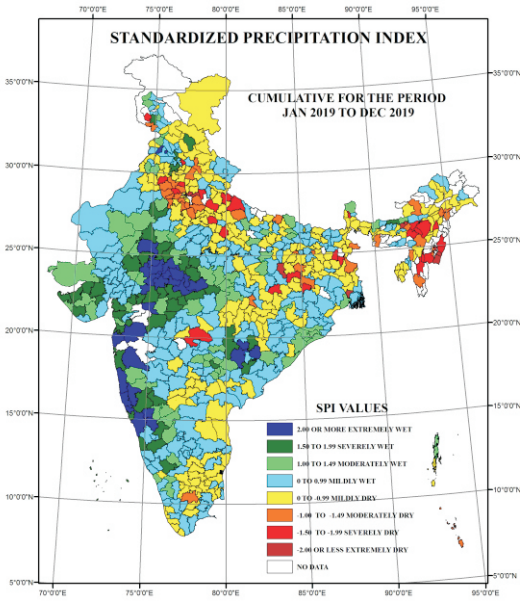
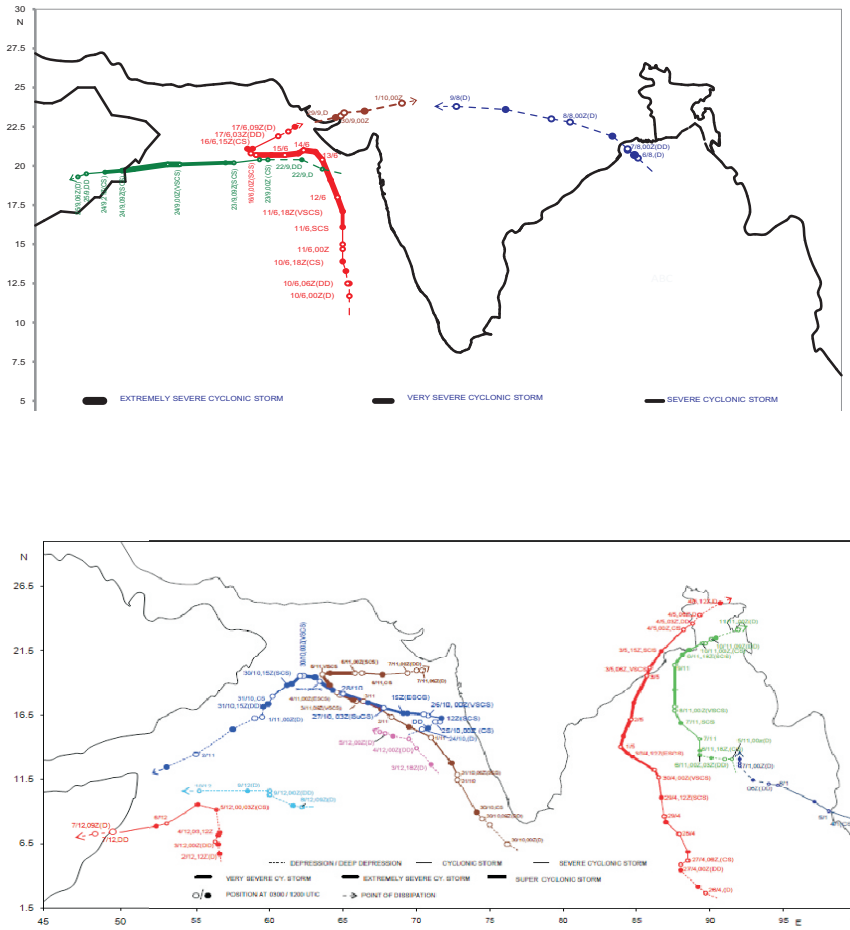


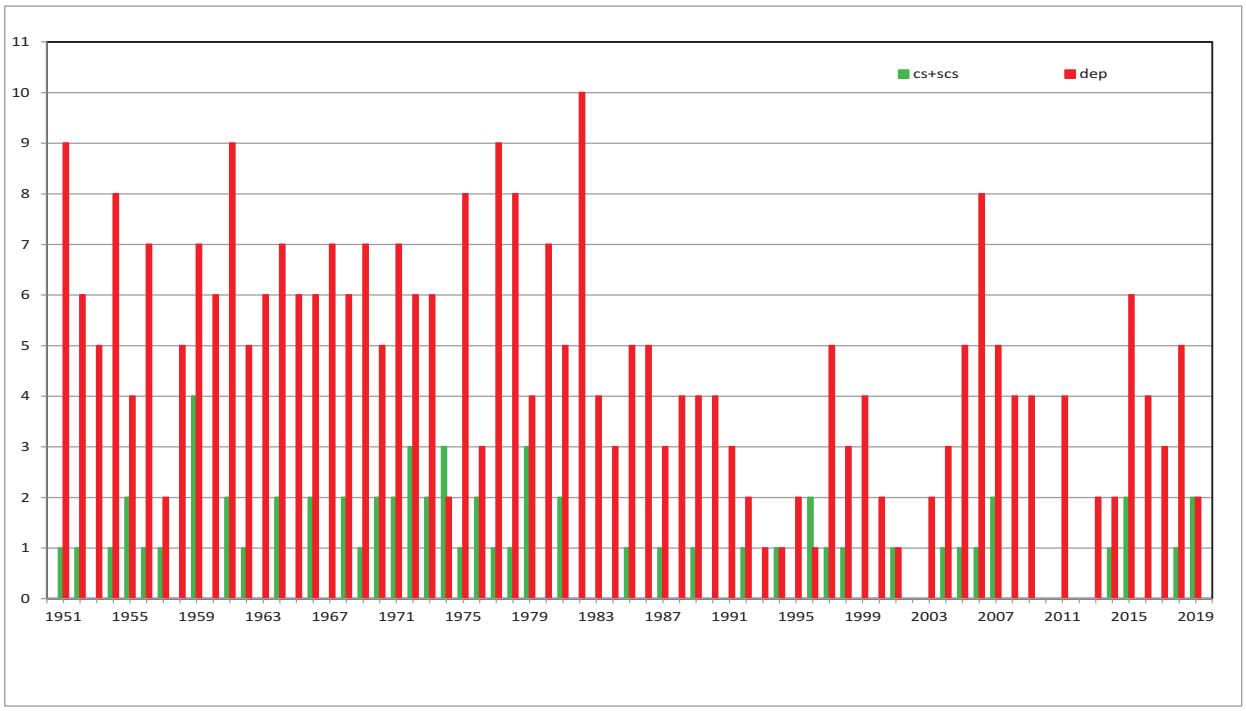
FIG. 11 : STANDARDIZED PRECIPITATION INDEX JAN - DEC 2019



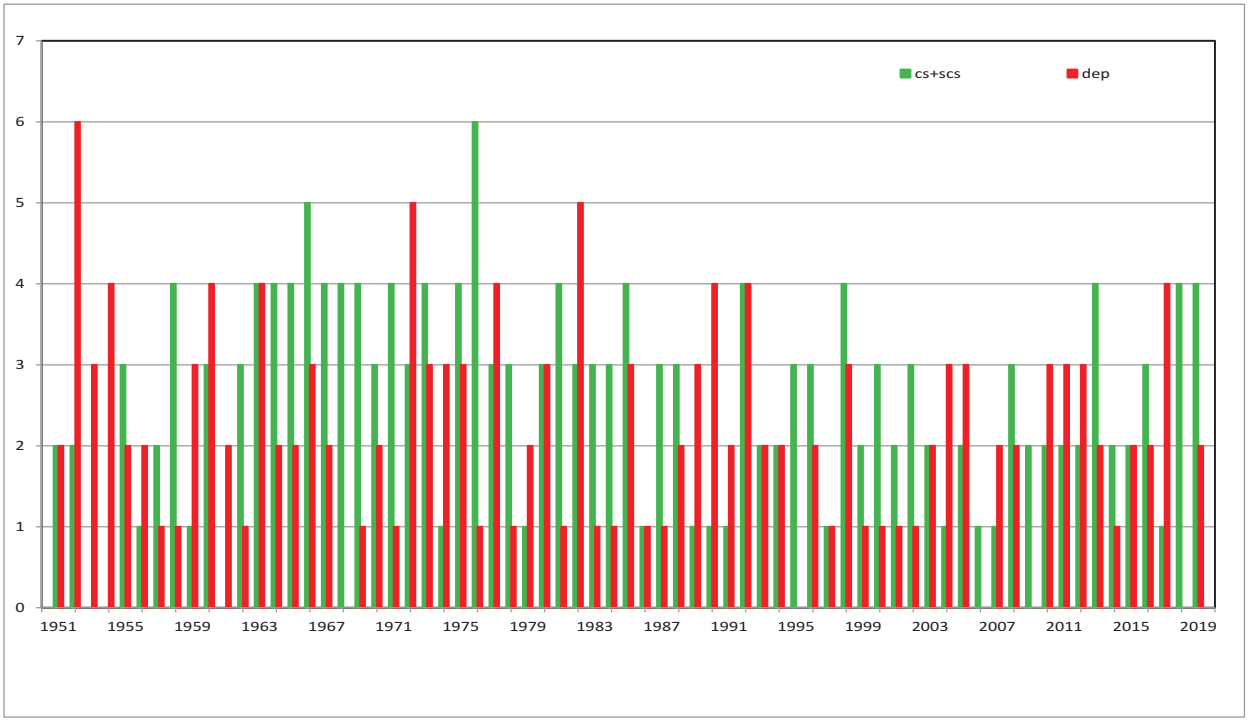
(a)

(b)

FIG. 12 : TRACKS OF DEPRESSIONS AND CYCLONIC STORMS FORMED DURING 2019
a) MONSOON SEASON b) OTHER SEASONS



(a) MONSOON SEASON (JUNE TO SEPTEMBER)



(b) POST MONSOON SEASON (OCTOBER TO DECEMBER)

FIG. 13 : FREQUENCY OF DEPRESSIONS AND CYCLONIC STORMS FORMED OVER THE NORTH INDIAN OCEAN & LAND (1951-2019)
(Source : Cyclone eatlas, RSMC New Delhi)

(a) 27 - 31 JANUARY 2019

(b) 27 - 31 DECEMBER 2019

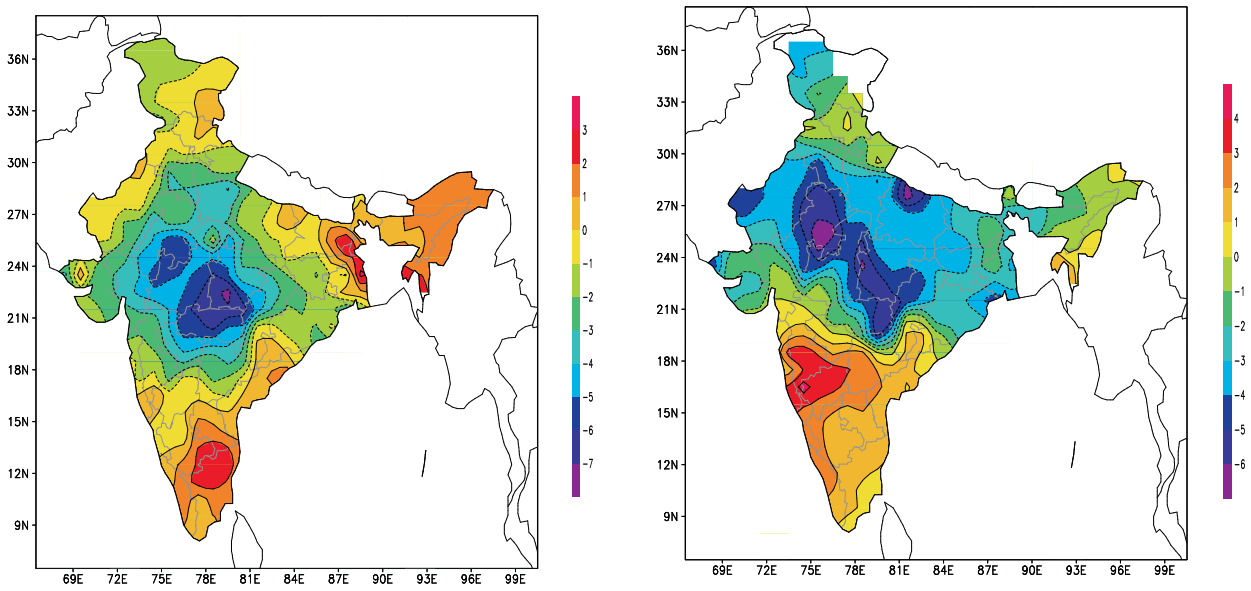


FIG. 14: MINIMUM TEMPERATURE ANOMALY (°C) DURING THE COLD WAVE PERIOD
(WITH RESPECT TO 1981 - 2010 AVERAGE)

(a) 28 April - 1 May 2019

(b) 10 - 15 JUNE 2019

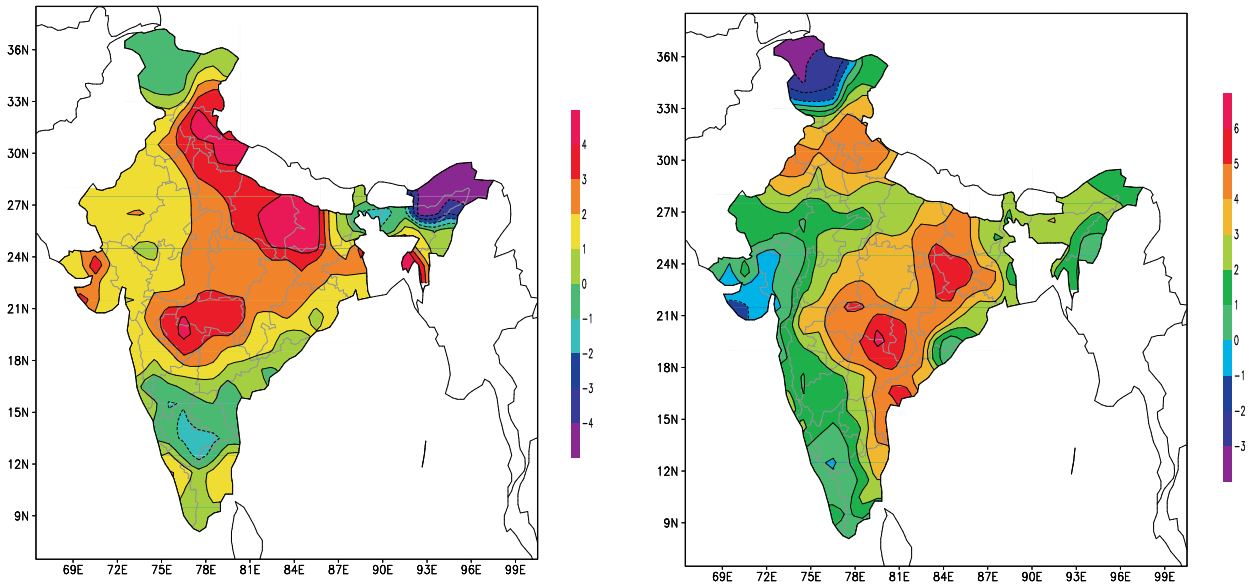


FIG. 15: MAXIMUM TEMPERATURE ANOMALY (°C)DURING THE HEAT WAVE PERIOD
(WITH RESPECT TO 1981 - 2010 AVERAGE)

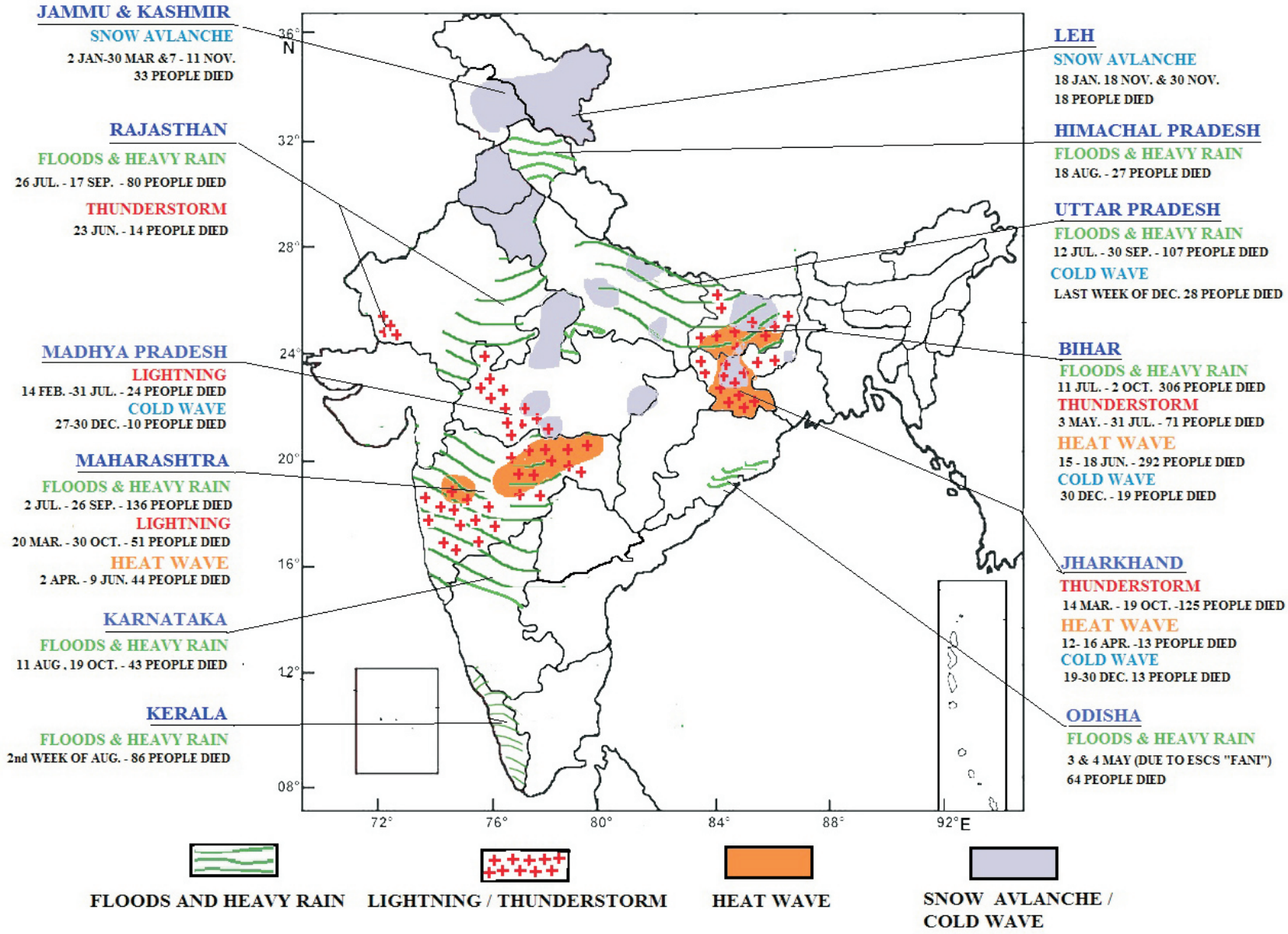


FIG.16 : SIGNIFICANT WEATHER EVENTS DURING 2019

TABLE - 1

METEOROLOGICAL SUB-DIVISION WISE SEASONAL AND ANNUAL RAINFALL STATISTICS FOR THE YEAR 2019 BASED ON UPDATED DATA

		Winter updated			Premonsoon updated			Monsoon updated			Post monsoon real time			Annual		
S.NO	SUB-DIVISION	ACT	NORMAL	%DEP	ACT	NORMAL	%DEP	ACT	NORMAL	%DEP	ACT	NORMAL	%DEP	ACT	NORMAL	%DEP
1	A & N ISLANDS	179.6	75.4	138.2	282.0	466.8	-39.6	2331.3	1653.8	41.0	293.0	675.8	-56.6	3086.0	2871.8	7.5
2	ARUNACHAL PRADESH	95.7	146.7	-34.8	573.4	772.9	-25.8	1541.4	1726.6	-10.7	145.4	267.4	-45.6	2355.8	2913.6	-19.1
3	ASSAM &MEGHALAYA	28.9	46.7	-38.2	659.6	587.8	12.2	1567.7	1773.7	-11.6	204.7	196.5	4.2	2460.9	2604.7	-5.5
4	NAG.,MANI.,MIZO.,TRIP	28.2	37.8	-25.3	310.1	483.0	-35.8	1133.2	1426.7	-20.6	186.3	221.0	-15.7	1657.8	2168.5	-23.6
5	S.H.W.B.&SIKKIM	40.4	45.9	-12.0	431.4	442.9	-2.6	1882.6	1970.8	-4.5	123.6	179.4	-31.1	2478.0	2639.0	-6.1
6	GANGATIC W.B.	90.0	32.8	174.4	221.3	185.8	19.1	952.4	1181.5	-19.4	244.1	156.4	56.1	1507.7	1556.5	-3.1
7	ORISSA	24.2	29.2	-17.2	148.6	128.4	15.8	1232.5	1155.3	6.7	188.6	131.3	43.6	1593.9	1444.2	10.4
8	JHARKHAND	25.6	28.2	-9.3	110.3	83.3	32.5	858.9	1054.7	-18.6	141.3	90.3	56.5	1136.1	1256.5	-9.6
9	BIHAR	30.8	20.1	53.3	69.3	81.7	-15.2	1049.4	1017.2	3.2	42.2	73.0	-42.2	1191.7	1192.0	0.0
10	EAST U.P.	33.5	25.5	31.3	9.7	32.4	-70.1	852.4	839.4	1.6	46.4	47.7	-2.6	942.0	945.0	-0.3
11	WEST U.P.	43.8	29.3	49.4	18.1	29.9	-39.5	523.8	721.3	-27.4	51.9	32.7	58.6	637.5	813.2	-21.6
12	UTTARANCHAL	201.8	101.4	99.0	101.1	155.3	-34.9	961.8	1176.9	-18.3	114.6	60.5	89.4	1379.3	1494.1	-7.7
13	HAR., CHANDI., DELHI	32.7	30.9	5.7	36.7	39.3	-6.6	258.6	444.0	-41.8	28.3	20.2	40.3	356.3	534.4	-33.3
14	PUNJAB	101.2	48.7	107.9	54.2	55.1	-1.5	434.5	467.3	-7.0	62.4	26.3	137.2	652.3	597.4	9.2
15	HIMACHAL PRADESH	279.3	192.7	45.0	134.5	243.4	-44.8	683.0	763.5	-10.5	121.4	91.6	32.6	1218.2	1291.2	-5.7
16	JAMMU & KASHMIR	356.9	225.6	58.2	219.3	336.1	-34.8	486.5	567.5	-14.3	253.3	134.4	88.5	1316.0	1263.6	4.1
17	WEST RAJASTHAN	7.1	8.8	-19.2	32.6	22.5	44.9	316.1	265.3	19.1	45.7	11.6	293.8	401.5	308.2	30.3
18	EAST RAJASTHAN	8.2	10.0	-17.7	26.5	19.0	39.4	920.6	602.9	52.7	37.8	25.8	46.5	993.2	657.7	51.0
19	WEST M.P.	6.6	12.5	-47.0	13.3	12.9	2.9	1383.0	857.7	61.2	68.5	50.9	34.6	1471.4	934.0	57.5
20	EAST M.P.	20.5	32.9	-37.8	24.6	23.6	4.1	1309.7	1048.4	24.9	59.9	57.4	4.4	1414.6	1162.3	21.7
21	GUJARAT REGION	0.4	1.5	-75.1	1.1	6.3	-81.9	1193.4	922.9	29.3	83.8	29.8	181.2	1278.7	960.5	33.1
22	SAURASHTRA & KUTCH	1.2	1.0	18.3	0.4	4.0	-89.9	839.7	507.2	65.6	63.9	27.5	132.4	905.2	539.7	67.7
23	KONKAN & GOA	0.0	0.7	-100.0	0.7	36.0	-98.1	4385.8	2875.3	52.5	281.5	139.6	101.7	4668.0	3051.6	53.0
24	MADHYA M'RASHTRA	0.0	2.9	-100.0	10.1	32.5	-69.1	1166.9	751.2	55.3	228.6	103.1	121.7	1405.6	889.7	58.0
25	MARATHAWADA	0.3	6.9	-95.3	5.2	27.4	-81.1	590.7	668.8	-11.7	257.3	100.0	157.3	853.6	803.1	6.3
26	VIDARBHA	12.3	17.8	-31.2	6.9	27.4	-74.9	1058.8	943.1	12.3	66.7	81.5	-18.2	1144.6	1069.8	7.0
27	CHATTISGARH	25.8	21.3	20.9	32.6	41.0	-20.5	1255.7	1142.1	9.9	106.2	76.7	38.5	1420.3	1281.1	10.9
28	COASTAL ANDHRA PRADESH & YANAM	11.9	22.4	-46.9	57.5	98.7	-41.8	641.5	586.9	9.3	300.7	338.1	-11.1	1011.6	1046.1	-3.3
29	TELANGANA	24.6	14.4	71.0	27.6	58.9	-53.2	806.9	759.6	6.2	172.6	123.7	39.6	1031.7	956.6	7.9
30	RAYALASEEMA	14.0	8.1	72.7	44.9	82.1	-45.3	460.0	411.6	11.8	225.4	223.3	0.9	744.3	725.1	2.6
31	TAMIL NADU,PUDUCHERRY & KARAIKAL	4.8	27.9	-82.8	51.5	126.4	-59.3	401.9	342.0	17.5	453.2	447.4	1.3	911.4	943.7	-3.4
32	COASTAL KARNATAKA	0.3	2.5	-88.6	45.0	155.7	-71.1	3787.7	3095.1	22.4	582.3	256.8	126.8	4415.3	3510.1	25.8
33	N.I.KARNATAKA	0.8	5.2	-84.7	42.8	80.0	-46.5	611.6	497.1	23.0	245.1	138.1	77.5	900.2	720.4	25.0
34	S.I.KARNATAKA	8.5	5.8	46.2	114.5	140.4	-18.4	839.1	681.8	23.1	307.7	204.1	50.8	1269.8	1032.1	23.0
35	KERALA & MAHE	13.1	22.4	-41.6	169.6	361.5	-53.1	2310.0	2049.3	12.7	625.0	491.6	27.1	3117.6	2924.8	6.6
36	LAKSHADWEEP	28.1	25.2	11.5	37.9	203.3	-81.4	1227.0	1013.1	21.1	874.3	321.8	171.7	2167.3	1563.4	38.6

TABLE - 2

STATION WISE TEMPERATURE AND RAINFALL EXTREMES[#] FOR THE YEAR 2019

S.NO.	STATION NAME	MIN (^{0}C)	DATE (MONTH_DATE)	MAX (^{0}C)	DATE (MONTH_DATE)	HIGHEST 24 Hr. RAINFALL(mm)	DATE (MONTH_DATE)
1	Agartala AP	8.9	1_31	37.6	5_1	158.6	6_1
2	Cherrapunji*	3.3	1_4	30.7	9_1	369.8	7_11
3	Dibrugarh AP	6.8	1_6, 12_30	37.5	8_6	116.6	6_15
4	Guwahati AP	7.3	1_7	39.2	8_7	92	10_26
5	Imphal AP	0.2	1_1	34.9	7_18	56.8	7_27
6	Passighat	11.4	1_6	38.2	8_6	136.6	9_9
7	Shillong*	1.8	12_18	29.5	8_12	192.4	7_10
8	Tezpur	9.4	1_1	37.2	8_6, 8_12, 8_26	89	7_29
9	Baghdogra AP	4.7	12_30	37.8	6_13	203	7_12
10	Berhampore	8.4	12_27	41.4	5_9	87	5_4
11	Kolkata	11.1	12_28	39.6	6_14	137.6	8_17
12	Cooch Behar AP	5.5	1_2	37.7	6_13	197.4	7_13
13	Contai	7.2	12_29	39	6_18	160.8	11_10
14	Darjeeling*	1	1_12	27.4	8_12	138.6	7_8
15	Gangtok*	2.9	3_1	27.5	8_12	117.8	6_25
16	Jalpaiguri	6.1	1_2	37.9	8_12	204	7_14
17	Kalimgpong*	3.5	12_29, 12_30	32.8	7_18	138	7_7
18	Krishnanagar	7.2	12_24, 12_29	39.6	6_14, 6_16	50.5	8_15
19	Midnapore	9.5	12_30	40.7	6_16	111	9_25
20	Panagarh	6.1	1_30	42.9	4_28	60	6_30
21	Balasore	7.6	12_28	40	6_14	141.8	10_25
22	Bhubaneshwar AP	9.5	1_1	43.7	4_16	161.2	5_4
23	Chandbali	10.2	12_29	41.1	5_22	150.1	11_9
24	Gopalpur	12	1_1	36.5	8_11, 9_22	169.3	5_3
25	Jharsugda AP	5.8	12_28	45.2	5_25, 6_5	167.5	8_8
26	Puri	12	12_29	37.8	6_18	166.5	10_24
27	Sambalpur	7.4	12_28, 12_29	45.6	6_12	165.6	9_8
28	Daltonganj	4.7	12_28	46.7	6_1	178	8_19
29	Gaya AP	2.4	12_30	45.6	6_10	92.1	9_29
30	Jamshedpur AP	7.2	12_28	43.4	5_30	101	9_12
31	Patna AP	4.8	12_28	45.8	6_15	151.9	9_29
32	Purnea	5.5	1_1	39.5	6_14	174.9	9_30
33	Ranchi AP	4.7	12_28	41.8	5_9	66.4	9_29
34	Allahabad AP	3.6	12_28	48.9	6_10	100	10_3
35	Bahraich	0.2	12_31	43	5_9	202	7_10
36	Bareilly	2.5	12_31	44	5_30	112	7_11
37	Dehar Dun	3.1	12_31	40.6	6_15	126.6	8_12
38	Gorakhpur	4	12_31	44	6_15	119.1	9_27
39	Jhansi	1.8	12_31	48.1	6_10	74.8	10_2
40	Lucknow AP	0.7	12_31	44.9	6_15	121.6	7_11
41	Mukteshwar**	-4.4	2_28	31	5_31	60	12_14
42	Varansai	2.3	12_30	46.4	6_10	130.6	9_27
43	Ambala	2.7	12_30	45	5_31, 6_11	127.5	7_15
44	Chandigarh	3.7	1_01, 1_15	44.2	6_11	91	8_18
45	Hissar	0.2	12_28, 12_29	46.4	6_10	69.1	5_18
46	Karnal	1.5	12_28	44.4	6_10	60.2	7_10
47	New Delhi AP	2.4	12_28	45.6	6_10	50.2	7_22
48	Amritsar AP	0.4	1_17	45.7	6_1	50.2	2_21
49	Patiala	3.2	1_18	45.8	6_10	178	9_5
50	Shimla*	-2.4	2_8	30.5	6_11	153.1	8_18
51	Banihal*	-5	2_2	33	9_10, 9_13	79.6	12_13
52	Gulmarg*	-14.4	2_9	22.2	7_5, 7_23	71	2_7
53	Jammu AP	2.4	12_30, 12_31	44.4	6_10	97.4	12_13
54	Srinagar*	-6.5	12_30	33.6	7_24	76.8	11_8
55	Ajmer	3.1	12_31	46.3	6_9	114.2	8_2
56	Barmer	6.2	12_31	47.2	6_2	58	11_14
57	Bikaner	2.6	12_29	48.4	6_3	79	8_17
58	Ganganagar	1.4	12_27	49.6	5_31	31.7	8_2
59	Jaipur AP	1	12_30	46.3	6_10	93.3	7_26
60	Jaisalmer	2.8	12_31	47.8	6_2	55.5	6_26
61	Jodhpur AP	4.4	12_27	46.4	6_2	116.9	7_29
62	Kota AP	2.8	12_29	48.3	6_9	151.8	7_28
63	Udaipur	2.6	12_28	44.8	6_2, 6_3	139.6	6_19
64	Ambikapur	3.8	12_28	44.2	6_12	93	7_7
65	Betul	2.3	1_8	44.7	6_5, 6_7	92.8	8_25
66	Bhopal(AP)	4.8	1_29	45.9	6_7, 6_9	166.5	7_30
67	Guna	2	12_29	46.8	6_10	144.8	7_26
68	Gwalior	2.2	12_30	47.8	6_10	102	9_23
69	Indore(AP)	5.6	1_29	44	6_7	114.3	7_6
70	Jabalpur	4.4	1_29, 12_28	46.8	5_31	200.2	8_15
71	Jagdalpur	6.4	1_1	42.4	5_9	288.5	9_6
72	Khandwa	5	1_30	46.1	4_28	242	8_31
73	Nowgong	2.2	1_16	49	6_10	150	9_13
74	Pendra	4.1	12_28	44.5	6_10	80.4	7_9
75	Ratlam	4.3	1_28	44.9	6_9	134.6	8_27
76	Sagar	2.5	12_29	47	6_3	108.6	9_9
77	Satna	5.1	12_27	47.2	6_11	116.6	8_14

TABLE - 2 (CONTD.)

78	Seoni	5	12_28	44.4	6_5	313.4	9_9
79	Umaria	1.3	12_29	46.7	6_11	89.3	7_6
80	Ahmedabad AP	8	1_2	44.4	6_2	108.7	8_10
81	Baroda	7.6	1_28	44.4	4_27, 4_28	556.8	8_1
82	Bhavnagar AP	8.6	1_30	43.7	4_27	114.5	9_9
83	Bhuj AP	7.2	12_30	44.2	4_26, 6_7	100.6	8_29
84	Deesa	6.4	2_8	45.1	6_7	77.7	8_16
85	Dwarka	13.6	1_28, 12_30	37.2	3_26	104.1	8_11
86	Naliya	3.6	12_28	39	4_14	275	8_11
87	New Kandala	8.4	12_31	45.2	4_27	213	8_10
88	Porbandar AP	9	12_30	43.6	4_27	122.4	9_2
89	Rajkot AP	8.3	12_30	44.7	4_27	216.3	7_30
90	Surat	11.5	1_30	43.6	4_28	191.6	7_1
91	Veraval	11.5	1_26	39.8	3_25	90.1	6_15
92	Akola	6.8	1_29	47.2	4_28	56.3	7_31
93	Ahmadnagar	4.6	1_1	45.1	4_27	122.6	7_21
94	Aurangabad AP	6.5	2_9	43.6	4_27, 4_28	45.2	9_23
95	Buldhana	7.6	1_29	44	4_28	61	6_27
96	Chandrapur	5.1	12_29	48	5_29	132.9	7_30
97	Dahanu	13	2_9	37.3	4_29	298.6	7_1
98	Harnai	13.7	2_9	35.7	10_16	139.6	9_5
99	Jalgaon	6	1_9	45.4	4_28	67	8_9
100	Kolhapur	13.1	2_9	41.2	5_19	128	8_6
101	Mahabaleshwar*	9	2_8, 2_9	36.2	4_12	380.4	8_5
102	Malegaon	6.2	2_10	44.6	4_27, 5_23	71	7_2
103	Mumbai	15.6	2_9	36.4	10_15	173.6	7_24
104	Nagpur AP	4.6	1_30	47.5	5_28	108.4	7_26
105	Panjim	15.9	2_9	36	2_13	151.7	10_25
106	Parbhani	7.5	1_01, 1_30	47.2	4_28	96.1	10_20
107	Pune	5.1	2_9	43	4_28	87.3	9_25
108	Ratnagiri	11.7	2_9	36.8	10_15	280.4	7_23
109	Sholapur	9.7	1_1	45	5_21	118	9_23
110	Yeotmal	6.4	1_29	45.8	6_6	65.6	7_31
111	Anantpur	12.4	1_2	43.3	5_21	60.2	9_22
112	Hyderabad AP	9.3	1_01, 1_30	43.4	5_26	89.7	9_27
113	Kakinada	16	1_1	43	5_4, 5_5, 5_6	74.7	10_23
114	Kalingapatnam	12.4	1_1	37	7_17	119.7	10_23
115	Kurnool	14	1_1	44.1	5_11, 5_19	57.2	9_24
116	Machilipatnam	16.6	1_1	43.5	6_19	73	10_6
117	Nellore	18.1	1_1	44.5	5_6	104.4	11_15
118	Nizamabad	10.1	1_30	45.9	5_28	80.5	9_21
119	Ongole	17.5	1_01, 1_30	44.7	5_6	137.4	9_17
120	Ramgundam	8.6	1_30	47.2	5_27	96	10_25
121	Visakhapatnam AP	12	1_1	43.6	6_15	87.2	10_23
122	Chennai AP	17.8	1_1	43	6_9	94.7	9_19
123	Coimbatore	16.2	1_5	39.6	4_12	106.4	8_9
124	Cuddalore	18.6	1_09, 1_10	41.4	6_22	166.4	12_1
125	Kanyakumari	19.7	1_1	36.7	4_10	88.5	11_30
126	Kodaikanal*	6	2_1	24.1	5_3	103	10_17
127	Madurai AP	17.2	1_3	42	5_28	76.4	8_19
128	Nagapattinam	19.5	1_15, 1_22	41.2	6_20	138.8	12_25
129	Palayamkottai	20.1	1_3	41.4	5_28	100	11_16
130	Pamban	22	1_20	36.2	4_28, 7_19	183	10_22
131	Salem	16.1	1_9	41.1	4_16	97	10_22
132	Tiruchirapalli AP	17.6	1_10	42.6	5_5	133	8_20
133	Vellore	14.6	1_15	44.5	5_27	165.7	8_17
134	Bangalore*	12.3	1_15	37	3_7, 4_27	58	2_10
135	Chitradurga	12.2	1_9	39.5	4_27	82.2	10_21
136	Gadag	11.8	1_1	40.5	5_19	67.6	10_22
137	Gulbarga	10.7	1_1	45.6	5_29	48.9	9_24
138	Honavar	16	1_21	36.2	3_23	152.2	8_6
139	Karwar	15.5	1_4	38.6	5_28	171	8_15
140	Mangalore AP	18	1_3	37.4	2_22, 2_23	138.4	8_13
141	Medikeri*	7.3	1_17	32.5	3_25, 3_28	193.8	8_8
142	Mysore	9.1	1_21	37.9	3_7	62	9_23
143	Raichur	11	1_3	43.5	5_7, 5_15, 5_29	115.2	9_25
144	Alapuzha	19.1	1_3	37.5	4_12, 4_15, 4_16	173.4	10_21
145	Cochi AP	19.8	1_4	35	5_22	160.4	10_21
146	Kozhikode	19.6	1_4	37.4	5_28	146	7_19
147	Thiruvananthapuram	18.9	1_22	38.2	2_20	100.7	8_10
148	Car Nicobar	11.1	1_16	40.8	10_3	193.8	5_16
149	Port Blair	20.6	3_11, 3_13	36.5	4_19	130.5	8_31
150	Amini Divi	19.8	1_23	36.4	5_16	301	10_31
151	Minicoy	19.5	1_22	37.2	3_22	212.6	12_2

(:Hill stations) (# : Based on Realtime data)*







ANNUAL CLIMATE SUMMARY - 2019

जलवायु निगरानी तथा विश्लेषण समूह
Climate Monitoring & Analysis Group

(Website : http://www.imdpune.gov.in)

डिजाइन एवं मुद्रित - मुद्रण विभाग,
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Note : This Bulletin is based on operational data and is subject to updating