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भारत मौसम विज्ञान विभाग / INDIA METEOROLOGICAL DEPARTMENT







वार्षिक जलवायु सारांश - 2016

ANNUAL CLIMATE SUMMARY - 2016

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NATIONAL CLIMATE CENTRE, CLIMATE SERVICES DIVISION

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COVER PHOTOS

Photo 1: 'Mahad bridge collapse' incidence, August 2, 2016. The ill-fated British-era Bridge on the Mumbai-Goa Highway in Raigad district of Maharashtra collapsed due to swelling of river Savitri after incessant rains since past 72 hours. (http://www.thehindu.com)

Photo 2: A farmer helplessly seeing his dried up cotton field at Chandampet Mandal in Nalgonda district, Telangana. April 25, 2016. (http://www.chinadailyasia.com)

Photo 3: A Kashmiri man crosses a wooden bridge in the interiors of Dal lake on a cold and foggy morning in Srinagar, Kashmir. Jan. 13, 2016. The Kashmir valley continued to reel under intense cold wave condition since the beginning of the year with night temperature remaining several notches below the freezing point on several occasions. (http://www.usnews.com)

Photo 4: Villagers wade through the flooded area in Katihar district of Bihar. August 29, 2016. Bihar faced one of the worst floods in the decade as all the major rivers passing through the state were flowing above the danger mark. (http://www.ndtv.com)

Photo 5: Every year Fog hampers normal life in north India during the winter season. Due to poor visibility, many trains and flights are delayed or cancelled or rescheduled. Seen in picture are men riding horse carts on a road covered with thick layer of Fog in Amritsar, Punjab. Dec 18, 2016.(http://www.oneIndia.com)

Photo 6: A mother and a child with his head covered with a wet towel to protect it from a heat wave, wait for transportation in Jammu. May 19, 2016. Scorching summer temperatures, hovering well over 40 degrees Celsius, made life extremely tough for millions of people across north India due to prolonged heat wave during the season. (https://www.yahoo.com/news)

वार्षिक जलवायु सारांश - २०१६

विशेषताये

वर्ष २०१६ में देश की जलवायु तापमान की दृष्टि से काफी ऊष्ण रही जो की वैश्विक तापमान में वृद्धि के अनुरूप है । देश का वार्षिक औसत तापमान इस वर्ष सन १९७१-२०१० के औसत से ०.८७ डिग्री सेंटीग्रेट (डि. से.) से अधिक रहा । यह साल १९०१ से अब तक का सबसे ऊष्ण साल रहा । जाड़े की ऋतु के औसत तापमान में वृद्धि (+१.३६ डि. से. एवं १९०१ से अब तक का तीसरा सबसे ऊष्ण ऋतु), पूर्व मानसून ऋतु के तापमान में वृद्धि (+ १.२२ डि. से. एवं १९०१ से अब तक का दूसरे क्रमांक का ऊष्ण ऋतु) और मान्सूनोत्तर ऋतु के तापमान में वृद्धि (+ ०.७५ डि. से. एवं १९०१ से अब तक की तीसरी सबसे ऊष्ण ऋतु) वार्षिक तापमान मे वृद्धि का मुख्य कारण है । अब तक के १० सबसे ऊष्ण साल इस क्रम से हैं : २०१६ (विसंगति +०.८७), २००९(+०.८५), २०१०(+०.८२), २०१५(+०.५९), २००६ (+०.५६), २००२(+०.४५), २००७(+०.४१७), २०१४(+०.४१५), १९९८(+०.४१) और १९५८(+०.३७)।

दक्षिणी पश्चिमी मानसून ऋतु (जून-सितंबर, जो देश की वर्षा ऋतु का प्रमुख काल माना जाता है) में देशभर में व्यापक रूप से वर्षा सामान्य रही (दीर्घ कालावधि औसत के ९७ %) । हालांकि सामयिक रूप से वर्षा अस्थाई थी लेकिन फिर भी देश भर में वर्षा का वितरण काफी अच्छा रहा ।

दक्षिण प्रायद्वीप (जिसमे ५ 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 पड़ने वाली उत्तर पूर्व मानसून वर्षा, सामान्य से काफी कम रही तथा पिछले ११६ सालों में (१९०१ -२०१६) अब तक की सबसे कम वर्षा थी ।

वर्षा

२०१६ में देश भर में वार्षिक वर्षा साधारण थी । वर्षा का प्रमाण दीर्घ कालावधि औसत के ९१ % रहा. देश के ३६ प्रभागों में से १ प्रभाग मे (पूर्व राजस्थान) वर्षा अतिरिक्त रही, २३ प्रभागों मे वर्षा सामान्य रही और १२ प्रभागों मे वर्षा सामान्य से कम रही ।

तापमान

देश के अधिकतर भागों में अधिकतम, निम्नतम और औसत तापमान की विसंगति -०.५ डि. से. से + १.० डि. से. की श्रेणी में रही । मगर देश के उत्तर, उत्तरपश्चिम, उत्तरपूर्व और दक्षिण प्रायद्वीप के काफ़ी भागों में औसत तापमान १ से २ डि. से. से अधिक रहा ।

चक्रवाती तूफ़ान

२०१६ मे बंगाल की खाड़ी में तीन चक्रवाती तूफान (मई, अक्तूबर और नवंबर मे प्रतिमाह एक) हुए और दिसंबर में एक तीव्र चक्रवाती तूफान हुआ । इनके अलावा मानसून ऋतु में १४ कम दबाव के क्षेत्र बने (२ अति

तीव्र कम दबाव क्षेत्र, २ तीव्र कम दबाव क्षेत्र, ३ अच्छी तरह से चिन्हित कम दबाव के क्षेत्र और सात कम दबाव के क्षेत्र) । इन सभी कम दबाव की प्रणालियों की वजह से संबन्धित स्थानो में अच्छी वर्षा हुई ।

महत्वपूर्ण मौसम संबंधी घटनाए

इस साल की सबसे महत्वपूर्ण घटना रही " ऊष्ण लहर " जिसमे अप्रैल और मई महीने मे ५०० से जादा लोगों के मृत्यु की सूचना प्राप्त हुई । मौत की काफी घटनाए मध्य तथा प्रयद्वीपीय भारत से सूचित की गई । इसमें से ३०० से अधिक लोगों के मृत्यु की सूचना तेलंगाना प्रभाग से प्राप्त हुई, ८७ गुजरात से, ४३ महाराष्ट्र से और बाकी देश के अन्य भागों से ।

आकाशीय बिजली से ४१५ लोगों के मृत्यु की सूचना प्राप्त हुई जो अधिकतर उत्तर , उत्तरपूर्व, मध्य तथा प्रायद्वीपीय भागों से थी । बिहार, उत्तर प्रदेश, मध्य प्रदेश तथा ओडिशा में इसकी संख्या सबसे अधिक थी । ओडिशा से ९७ लोगों के मृत्यु की सूचना प्राप्त हुई, उत्तरप्रदेश से ५२, बिहार से ४९, मध्य प्रदेश से ६० तथा बाकी शेष देश के अन्य भागों से ।

भारी वर्षा और बाढ़ संबंधी घटनाओं से मानसून ऋतु मे करीब ६०० से ज्यादा लोगों के मृत्यु की सूचना प्राप्त हुई । बिहार राज्य बाढ़ से सबसे जादा प्रभावित रहा जहाँ से २५ जुलाई से ३ सितंबर तक १४६ लोगों की मृत्यु हुई । मानसून ऋतु मे महाराष्ट्र से ६५ लोगों के मृत्यु की सूचना प्राप्त हुई, उत्तराखंड से ५८, राजस्थान से ४९, असम से ३५, मध्य प्रदेश से ४८ और बाकी देश के अन्य भागों से ।

पूर्व मानसून और मानसून ऋतु मे अंधितूफान से १०० से भी अधिक लोगो के मृत्यु की सूचना प्राप्त हुई। इसमे से काफी घटनाए उत्तर / उत्तर पूर्व तथा मध्य भारत के भागों से सूचित की गयी । इसमे से 40 लोगों की मौत 17-22 जून के बीच उत्तर प्रदेश राज्य से, और 36 लोगों की मौत असम राज्य से सूचित की गयी ।

HIGHLIGHTS

ANNUAL CLIMATE SUMMARY 2016

HIGHLIGHTS

Climate during 2016 was significantly warm in respect of temperature in line with the warmer than normal global climate observed during the year. The annual mean temperature for the country this year was +0.87 ^{0}C above the 1971-2000 average, thus making the year 2016 as the warmest year on record since the nation-wide records commenced in 1901. The country averaged seasonal mean temperatures during the winter season (January- February, with anomaly +01.36^{0}C, third warmest since 1901), the pre-monsoon season (March-May, with anomaly +1.22^{0}C, second warmest since 1901) and the post-monsoon season (Oct-Dec, with anomaly +0.75^{0}C, third warmest since 1901) mainly account 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 (97 % of Long Period average (LPA)). Though the season was marked with temporal variability, seasonal rainfall was fairly well distributed over all parts of the country.

The Northeast monsoon rainfall activity, over the south peninsula (core region of northeast monsoon rainfall activity comprising of 5 subdivisions viz. Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu & Pondicherry, South Interior Karnataka and Kerala) was substantially below normal (only 35% of LPA) and was the lowest for the region in last 116 years (1901-2016).

TEMPERATURE

Annual:

Spatial pattern of annual mean, maximum and minimum temperature anomalies for 2016 is shown in Fig.1. Anomaly in the maximum, minimum and mean temperature over many parts of the country was generally in the range of -0.5 to 1.0^{0} C. However, many parts of northern, northwestern, northeastern and south peninsular region of the country were warmer by about 1 to 2 ^{0}C.

The annual mean temperature for the country was +0.87 ^{0}C above the 1971-2000 average, thus making the year 2016 as the warmest year on record since 1901 (Fig. 2a). The other 9 warmest years on record in order were: 2009 (anomaly +0.85^{0}C), 2010 (0.82), 2015 (0.59), 2006(0.56), 2002(0.45), 2007 (0.417), 2014(0.415), 1998(0.41) and 1958(0.37). It may be mentioned that 12 out of the 15 warmest years were from the recent past sixteen years (2001-2016). Also the past decade (2001-2010/ 2007-2016) was the warmest decade on record with anomalies of 0.46^{0}C / 0.51^{0}C above average. During 1901-2016, the annual mean temperature showed an increasing trend of 0.64 ^{0}C/100 years with significant increasing trend in maximum temperature (1.04^{0}C /100 years), and relatively lower increasing trend (0.25^{0}C/100 years) in 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 1901-2016 are shown in Figs 2b, 2c, 2d and 2e respectively. **The mean temperature for the winter season (with anomaly +1.36^{0}C above average) this year was the third highest since 1901.** The 5 warmest winter years in order were 2006(with anomaly +1.76 ^{0}C), 2009(1.45), 2016(1.36), 2010(0.83) and 1966(0.79). January month (with anomaly +0.93 ^{0}C) was the fourth warmest and February (with anomaly,+1.8^{0}C) this year was the second warmest since 1901. The pre-monsoon season (March-May) this year was also significantly warmer. The season this year with anomaly +1.22^{0}C above average was the second warmest ever since 1901. The five warmest pre-monsoon years in order are 2010(1.72), 2016(1.22), 1921(0.97), 2009(0.82) and 1953(0.78). March, April and May months were the third, second and sixth warmest respectively since 1901.

Monsoon season this year (with anomaly +0.45^{0}C above average) was the 5th warmest since 1901. The 10 warmest monsoon years on record in order are 2009 (0.76), 2014(0.69), 1987(0.67), 2015(0.58), 2016(0.45), 2005(0.43), 1998(0.42), 2012(0.41) and 1915(0.39). Considering the individual months of the monsoon season, August (with anomaly 0.68^{0}C) was the third warmest since 1901 and September (with anomaly 0.42^{0}C) was the fifth warmest since 1901.

The Post-monsoon season this year (with anomaly +0.75^{0}C above average) was the 3rd warmest since 1901. The 5 warmest Post-monsoon years on record in order are 2015 (0.98), 2008(0.88), 2016(0.75), 2011(0.64) and 1979 (0.62). Considering the individual months of the post-monsoon season, October (with anomaly +0.68^{0}C) was the fifth warmest since 1901 and December (with anomaly +1.12^{0}C) was the second warmest since 1901.

Spatial pattern of trend in mean annual temperature anomalies based on the data for the period 1901-2016 (Fig.3) suggests significant positive (increasing) trend over most parts of the country except for some parts of Gujarat and Bihar, where significant negative (decreasing) trend was observed.

Fig.4 shows the spatial pattern of monthly maximum and minimum temperature anomalies. Regions with significant temperature anomaly (> or < $\pm$ 2 ^{0}C) during each concerned month are discussed below.

January-February (Winter season):

During January, maximum temperature was above normal by 2 to 4^{0}C over parts of Jammu & Kashmir and adjoining Himachal Pradesh, Rajasthan, Gujarat, West Madhya Pradesh, Vidarbha, Marathwada and Telangana. It was below normal over parts of Gangetic West Bengal by about 2^{0}C. Minimum temperature was above normal over parts of West Rajasthan, Saurashtra & Kutch, West Madhya Pradesh and Jammu & Kashmir by 2 to 3^{0}C.

During February, maximum temperature was above normal by about 2 to 3 ^{0}C over parts of north peninsula, eastern and northern parts of the country.

Over parts of Jammu & Kashmir and Himachal Pradesh, it was above normal by about 4 to 5 ^{0}C. Minimum temperature was above normal by about 2 to 4 ^{0}C over parts north peninsula, eastern and northern region and by over 4 ^{0}C over parts of Nagaland, Manipur, Mizoram & Tripura.

March- May (Pre-monsoon season):

During March, maximum temperature was above normal over parts of west Madhya Pradesh, East Rajasthan, West Uttar Pradesh, Uttarakhand, Himachal Pradesh, Telangana, Rayalaseema, South Interior Karnataka and Gujarat by about 2 to 3^{0}C. Minimum temperature was above normal by 2 to 3 ^{0}C over parts of northern/northwestern and westcentral India, Bihar, Jharkhand, Vidarbha, Marathwada, Telangana, Rayalaseema, North Interior Karnataka, Tamil Nadu, Nagaland Manipur Mizoram & Tripura and the Andaman & Nicobar Islands.

During April, over central parts of peninsula, maximum temperature was above normal by about 2 to 3 ^{0}C and over most parts of northern and eastern region, it was above normal by about 2 to 4 ^{0}C. Similarly, minimum temperature was above normal over most parts of northern and eastern region and some parts of north peninsula, by about 2 to 3^{0}C.

During May, parts of Rajasthan and Andaman & Nicobar Islands were warmer by more than 2 ^{0}C in respect of both maximum and minimum temperature, whereas parts of Gujarat were warmer by more than 2 ^{0}C in respect of minimum temperature.

June-September (Monsoon season):

During all the months of monsoon season, in respect of maximum temperature, positive or negative temperature anomaly was generally within 1 to 2 ^{0}C range. However, during June, maximum temperature was below normal by 2 to 3 ^{0}C over parts of Coastal Andhra Pradesh and Telangana, during August it was above normal by more than 2^{0}C over most parts of extreme northeastern region and some parts of Bihar, Coastal Andhra Pradesh and Kerala and during September, over parts of Jammu & Kashmir and Himachal Pradesh, maximum temperature was above normal by 2 to 3 ^{0}C and over parts of North Interior Karnataka and adjoining Telangana and Rayalaseema, it was below normal by 2 to 3 ^{0}C.

In respect of minimum temperature, all the months of the season were generally warmer and the anomalies were within 1-2 ^{0}C range over most parts of the country. However, during September, parts of Jammu & Kashmir, Himachal Pradesh and Uttarakhand were warmer by about 2 to 3 ^{0}C.

October-December (Post-monsoon season):

During all the three months of monsoon season, in respect of both maximum and minimum temperature, both positive or negative temperature anomaly was generally within 1 to 2 ^{0}C range. However, during December, maximum temperature was above normal by 2 to 3^{0}C over parts of northern, northwestern and extreme northeastern region of the country. Over parts of Jammu & Kashmir, Himachal Pradesh and West Rajasthan, maximum temperature was above normal by more than 4^{0}C. Maximum temperature was below normal by 2 to 3 ^{0}C over parts of East Uttar Pradesh and adjoining Bihar during December.

In respect of minimum temperature, some central and adjoining north peninsular parts of the country viz. Vidarbha and adjoining parts of Madhya Pradesh, Madhya Maharashtra, Marathwada, Telangana, Chattisgarh and parts of East Uttar Pradesh, Odisha and Gangetic West Bengal were cooler than normal by 2 to 3 ^{0}C during November. While during December, in respect of minimum temperature, some northern, northwestern and extreme northeastern parts of the country viz. Jammu & Kashmir, Himachal Pradesh, Rajasthan, Saurashtra & Kutch, Bihar and Nagaland, Manipur, Mizoram & Tripura were warmer by more than 3 to 4 ^{0}C.

Fig.5 (a,b) shows the monthly minimum and maximum temperature anomaly for the country as a whole during past five years, 2012-2016 respectively. It can be seen that the first four months of the year 2016 from January to April were the warmest in last five years, in respect of both minimum and maximum temperature. While August and September were the warmest in respect of minimum temperature and November and December were the warmest in respect of maximum temperature in last five years. Similarly, November month was relatively cooler in respect of minimum temperature in last five years.

Cold Wave / Cold day / conditions

Cold wave conditions were rather moderate during the winter season (Jan-Feb). Severe cold wave/cold day conditions prevailed over parts of north, central and north peninsular India only during fourth week of January (21-27 Jan.). Fig 14a, b show the minimum temperature anomaly diagrams for the duration when cold wave condition was at its peak.

Heat Wave Conditions

Unusually warm winter season this year was followed by hot March. As the season progressed, heat wave was more intense during April which was followed by excruciatingly hot May which shattered many previous records.

During the season, heat wave conditions were initially observed over the central and adjoining western/northwestern parts of the country from last week of the March to first week of April (24th March to 4th April). These conditions generally prevailed over most parts of eastern India during the second week of April. As the season progressed, the severity and extent of heating increased during the third week of April resulting in the establishment of severe heat wave conditions over parts of north and eastern India. These conditions continued to prevail over east India and also spread over parts of south India during the last week of April. During the last few days of April and the first fortnight of May, heat wave conditions were observed at isolated places on some occasions over Parts of Rajasthan, Punjab, Odisha, Bihar, Gangetic West Bengal and Kerala.

Since 15th May, severe heatwave / heatwave conditions again prevailed initially over parts of northwest India and spread subsequently over parts of central and north peninsular India till 22nd May. Jammu & Kashmir, West & East Rajasthan, West & East Madhya Pradesh and Vidarbha were especially affected by heat wave during this period. Maximum temperature at many places was around 47 ^{0}C during this period.

Heat wave conditions gradually abated from most parts of the country after 23rd May and prevailed only at isolated places over parts of Coastal Andhra Pradesh and Telangana during last few days of May. These conditions again revived and prevailed over parts of central and northwest India on most of the days during first ten days of the June. West & East Rajasthan and West Madhya Pradesh were especially affected during this period. The severity and spatial extent of Heat wave conditions reduced gradually and got abated by 12th June. Fig 15a, b show 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 2016, annual rainfall over the country as a whole was 91 % of its LPA value. Season wise rainfall distribution over the country as a whole is listed below:

Winter (January to February): **44% of LPA ,** Pre-monsoon (March to May): **100% of LPA**

Monsoon (June to September): **97% of LPA ,** Post-monsoon (Oct to Dec): **55% 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 normal (91 % of LPA) during the year. Out of 36 meteorological subdivisions, only one sub-division (East Rajasthan) received excess rainfall, 23 received normal rainfall and remaining 12 subdivisions received deficient rainfall.

At the end of year, of the four homogeneous regions, central India and East & Northeast India received normal rainfall (103% and 91 % of its LPA respectively), while Northwest India and south peninsular India received below normal rainfall (85% and 79 % of its LPA respectively).

Winter season:

Rainfall activity over the country as a whole was substantially below normal during the season. It was the seventh lowest since 1901. It was below normal during both the months of the season (41% of LPA during January and 46% of LPA during February). Only some subdivisions of peninsular and northeast India viz. South Interior Karnataka, Rayalaseema, Gangetic West Bengal and Nagaland, Manipur, Mizoram & Tripura and the islands received excess/normal rainfall, while rest of the country received deficient/ large deficient rainfall.

During the season, out of 36 meteorological subdivisions, 1 subdivision (Lakshadweep Islands) received large excess rainfall, 2 received excess rainfall, 3 received normal rainfall, 11 received deficient rainfall and 16 subdivisions received large deficient rainfall. Remaining 3 subdivisions did not receive any rain.

Pre-monsoon season:

Rainfall activity over the country during the season as a whole was normal (99.8 % of its LPA value). It was normal during March and May (99 % and 107 % of LPA respectively) and below normal during April (81% of LPA). Sub divisions of western India, Odisha and the Islands received deficient/ large deficient rainfall, while rest of the country received excess/normal rainfall. Some subdivisions of north, central and peninsular India viz. East & West Uttar Pradesh, Haryana, Chandigarh & Delhi, East Madhya Pradesh and Coastal Andhra Pradesh received about one and half times of their respective normal rainfall.

During the season, out of 36 meteorological subdivisions, 8 received excess rainfall, 16 received normal rainfall, 9 received deficient rainfall and 3 received large deficient rainfall.

Monsoon season:

The southwest monsoon season rainfall over the country as a whole was normal. However, the season observed intra seasonal variation with slightly below normal rainfall in June (89 % of LPA) and normal rainfall during July (107 % of LPA), August (91 % of LPA) and September (97 % of LPA). Spatially, the highest rainfall (106% of LPA) was received by homogeneous region of Central India and lowest rainfall (89% of LPA) was received by East & Northeast India. The homogeneous regions of Northwest India and South Peninsula received seasonal rainfall of 95% and 92% of LPA respectively. Also, during the first half of the season (1 June to 31 July) country received normal rainfall (100 % of its LPA), while during second half of the season (1August to 30 September) it received comparatively less rainfall (93 % of its LPA).

Many subdivisions of the country received excess/ normal rainfall. However, nine subdivisions received deficient rainfall. Out of these 9 deficient subdivisions, 3 were from Northwest India (Haryana, Chandigarh & Delhi, Punjab and Himachal Pradesh), one subdivision each from East & Northeast and Central India (Assam & Meghalaya and Gujarat region respectively) and 4 subdivisions from South Peninsular India (Coastal Karnataka, South Interior Karnataka, Kerala and Lakshadweep). During the season, out of 36 meteorological subdivisions, 4 subdivisions received excess rainfall, 23 received normal rainfall and the remaining 9 subdivisions received deficient rainfall.

The rainfall for the season was normal over the Northwest, Central and South peninsular India (95%, 106% and 92% of LPA respectively) and slightly below normal over the East & Northeast India (89% of LPA).

Daily area weighted rainfall (mm) over the country as a whole during the monsoon season 2016 (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 about 22 occasions, it was nearly one and half times its normal Value. However, during first fortnight of June and from mid of August to mid of September, it was almost continuously below normal.

Post-monsoon season:

Rainfall activity over the country during the season as a whole was below normal (55% of LPA). It was the fifth lowest since 1901. It was below normal during all the three months of the season (67%, 25% and 50 % of its LPA respectively). Except for some subdivisions of western, central and northeastern region and the Andaman & Nicobar Islands which received excess/normal rainfall, rest of the country received deficient/ large deficient rainfall.

Rainfall activity over the core region of south peninsula (comprising of 5 subdivisions viz. Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu & Puducherry, South Interior Karnataka and Kerala) **during the season as a whole was substantially below normal (35% of LPA value). It was the lowest over the region since 1901. All the five sub-divisions of the region received large deficient (<-60% of LPA) rainfall during the season.** Rainfall realized was substantially below normal during October and November (28% and 25 % of LPA respectively) and near normal during December (107% of LPA).

Out of 36 meteorological subdivisions, 3 subdivisions received large excess rainfall, one received excess rainfall, 6 received normal rainfall and 13 subdivisions each received deficient/ large 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 2016.

Cumulative SPI values of the year indicate, extremely wet/severely wet conditions over parts of Jharkhand, East Uttar Pradesh, West & East Rajasthan, West & East Madhya Pradesh, Konkan & Goa and North Interior Karnataka while extremely dry/severely dry conditions were observed over parts of Arunachal Pradesh, Assam & Meghalaya, Nagaland, Sub Himalayan West Bengal & Sikkim, Odisha, Jharkhand, Bihar, East & West Uttar Pradesh, Uttarakhand, Haryana, Chandigarh & Delhi, Punjab, Himachal Pradesh, Jammu & Kashmir, East Madhya Pradesh, Coastal Andhra Pradesh, Tamil Nadu, Karnataka state, Kerala and Lakshadweep.

TROPICAL STORMS / DEPRESSIONS IN THE INDIAN SEAS

During 2016, three cyclonic storms (one each in the month of May, October and November) and a very severe cyclonic storm (in the month of December) formed over the Bay of Bengal.

The first **cyclonic storm** of the year **'ROANU'** formed over the southwest Bay of Bengal in the month of May on 19th. After recurving, it skirted along the east coast of the country, crossed the Bangladesh coast and weakened over northeastern parts of the country on 22nd. This system caused good rainfall along the east coast of the country from 17 to 21 May and also over the northeastern parts of the country after weakening on 22nd May. The second cyclonic storm of the year **'KYANT'** formed over the east central Bay of Bengal in the month of October. However, after recurving it weakened in-situ over the sea itself over the west central Bay of Bengal off Andhra coast without causing adverse weather. The third Cyclonic Storm **'NADA'** formed over the south Bay of Bengal on 30th November. It moved in a northwesterly direction towards land but weakened into a depression over the Sea before crossing north Tamil Nadu coast on 2nd Dec. The crossing phase of this system caused active northeast monsoon conditions over Tamil Nadu for the first time during the season on 1st & 2nd Dec. The last cyclonic storm of the year **'VARDAH'** (6 -13 Dec) intensified into a Very Severe Cyclonic Storm and crossed north Tamil Nadu coast, close to Chennai on 12th. Thus, it became the system of severe intensity during the current year which had a landfall. Though it created havoc over Chennai and adjoining districts of north Tamil Nadu, the system also caused copious rainfall over the large rainfall deficient regions for a couple of days.

During the monsoon season, fourteen low pressure systems (2 Deep Depressions, 2 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	DD	D	WML	LPA
June	**0**	**1** (AS)	**0**	**1** (BOB)
July	**0**	**1** (Land)	**0**	**1** (Land)
August	**2** (BOB)	**0**	**2** (BOB)	**3** (2 BOB, 1Land)
September	**0**	**0**	**1** (BOB)	**2** (BOB)
(AS : Arabian Sea)			(BOB : Bay of Bengal)	

The first Depression of the monsoon season formed over the northeast Arabian Sea in June (27th–29th) and the second one formed as a Land Depression over northeast Madhya Pradesh & neighborhood in July (6th–7th). Thereafter, two Deep Depressions were formed in August (9th–12th & 16th–20th); 1st over the coastal areas of West Bengal & adjoining north Bay of Bengal and the 2nd over the northwest Bay of Bengal. Most of these depressions and the low pressure areas moved in a westerly/north-westerly direction across eastern, central or north peninsular parts of the country and caused above normal rainfall over these regions.

During the post monsoon season, apart from the storms mentioned above, two depressions were also formed. One formed over the Bay of Bengal (2-6 November) and another over the Arabian sea (17-18 December). The tracks of these cyclonic storms and depressions formed during the year is shown in figures 12 (a) and 12(b).

Frequency of depressions and cyclonic storms formed over the north Indian Ocean (1951-2016) during the monsoon and post-monsoon season is shown in figures.13 (a) and 13(b).

SIGNIFICANT WEATHER EVENTS

The most striking event of the year was the heat wave which was the replicate of the heat wave of the last year. Many stations of northwest, central and peninsular India witnessed unprecedented high temperatures and smashed the heat records of previous years during April and May. Some places in west Rajasthan viz. Phalodi and Churu recorded a high of about 50 ^{0}C on 19th May. The maximum temperature recorded at Phalodi (51°C on 19th May) was the highest-ever temperature for the country. The previous highest ever temperature (50.6°C) was recorded by Alwar also in Rajasthan in 1956. Over 500 deaths were reported mostly from central and peninsular parts of the country during the month of April & May. Of these, over 300 deaths were reported from Telangana alone. Over 100 from Andhra Pradesh, 87 from Gujarat, 43 from Maharashtra and rest from other parts of the country.

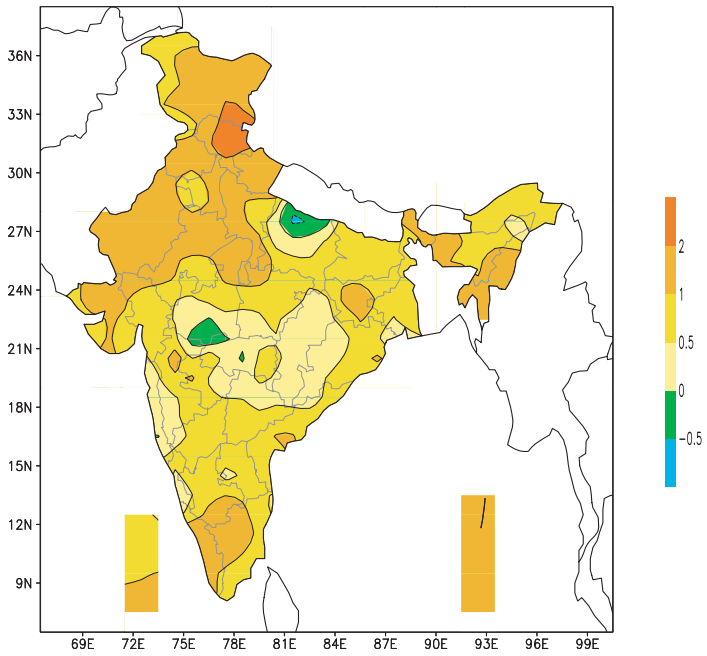
Lightning reportedly claimed over 415 deaths from northern, northeastern, central and peninsular parts of the country during the premonsoon and monsoon seasons. Neighbouring states of Bihar, Uttar Pradesh, Madhya Pradesh and Odisha were the worst affected. 97 deaths were reported from Odisha, 52 from Uttar Pradesh, 49 from Bihar, 60 from Madhya Pradesh and remaining from other parts of the country.

Heavy rain & flood related incidents during the monsoon season claimed at least 630 lives from different parts of the country. The worst affected state was Bihar where 146 people died during the period 25th July to 3rd September. Total 65 persons died in Maharashtra, of these 27 died in the 'Mahad bridge collapse' incidence, in Raigad district on 2nd August, 30 deaths were reported from Andhra Pradesh from 15-28 September and 20 deaths from Telangana during August and September months. Many areas in both these states were reeling under flood like conditions during last 10 days of September. Both the National Disaster Response Force and the Indian Army was called on to undertake the relief and the rescue operations in both these states. 58 deaths (all in month of July) were reported from Uttarakhand, 49 from of Rajasthan (11th July to 30th August) , 35 from Assam (19 July to 13 August), 48 from Madhya Pradesh (30 June-20 August) and rest from other parts of the country.

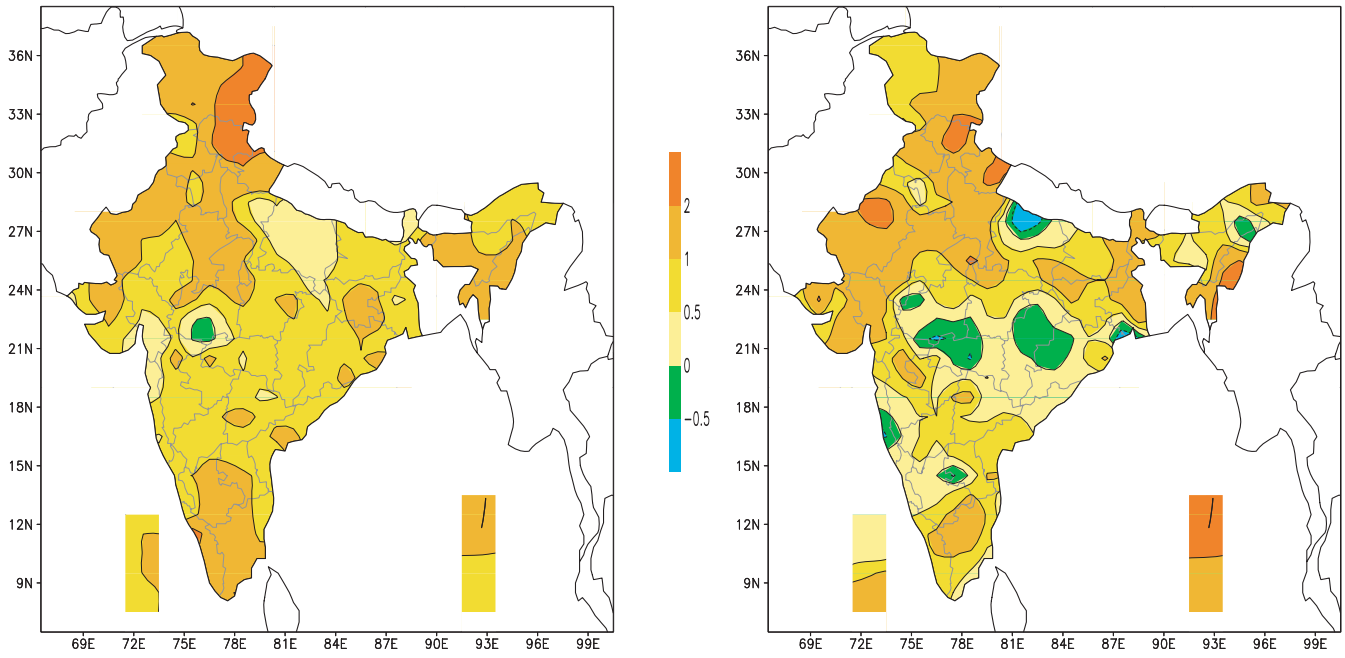
Thunderstorm activity also reportedly claimed about 100 deaths during the pre monsoon and monsoon season mostly from northern / northeastern and central parts of the country. Of these, 40 deaths were reported from Uttar Pradesh state alone during the period 17-22 June. 36 deaths were reported from Assam.

Significant weather events during 2016 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 2016 with the dates of occurrences are given in Table 2.



(a) MEAN



(b) MAXIMUM

(c) MINIMUM

FIG. 1 : ANNUAL TEMPERATURE ANOMALIES (°C)
FOR 2016 WITH RESPECT TO 1971 - 2000 AVERAGE

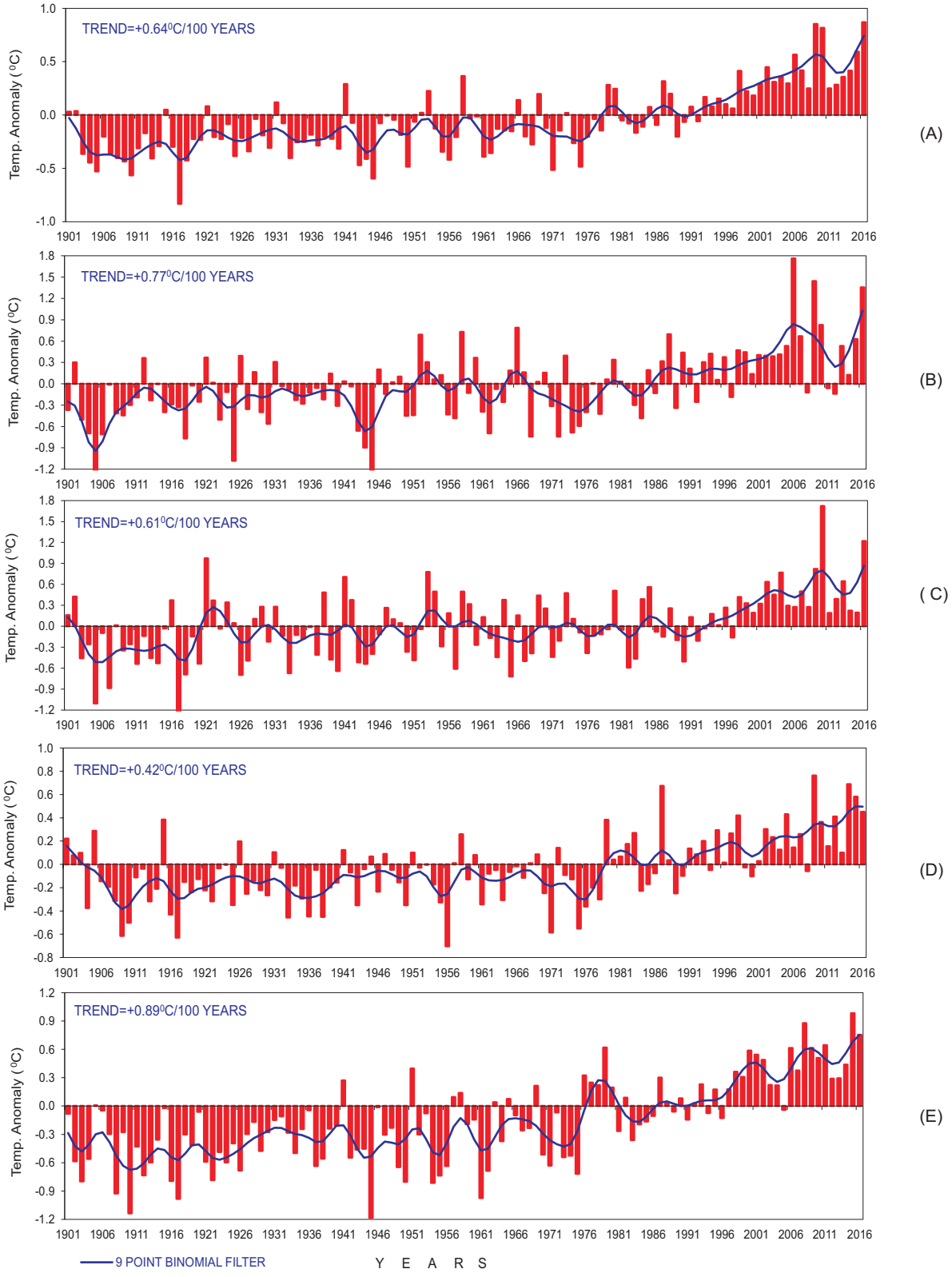


FIG. 2 : ALL INDIA MEAN TEMPERATURE ANOMALIES (A) ANNUAL, (B) WINTER, (C) PRE MONSOON, (D) MONSOON AND (E) POST MONSOON FOR THE PERIOD 1901 - 2016 SHOWN AS VERTICAL BARS. THE SOLID BLUE CURVE HAD SUB-DECADAL TIME SCALE VARIATIONS SMOOTHED WITH A BINOMIAL FILTER
(DEPARTURES FROM THE 1971 - 2000 AVERAGE)

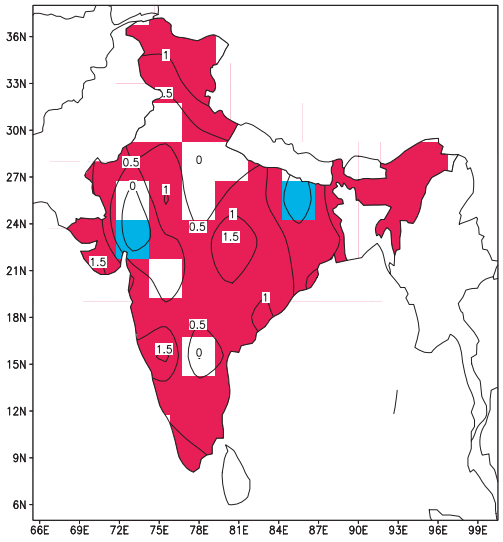


FIG. 3 : ANNUAL MEAN TEMPERATURE TRENDS (°C / 100 YEARS) ARE SHOWN AS CONTOUR LINES. THE TRENDS SIGNIFICANT AT 95% LEVEL ARE SHADED. POSITIVE TRENDS ARE SHOWN IN RED WHILE THE NEGATIVE TRENDS ARE SHOWN IN BLUE. PERIOD OF ANALYSIS : 1901 - 2016

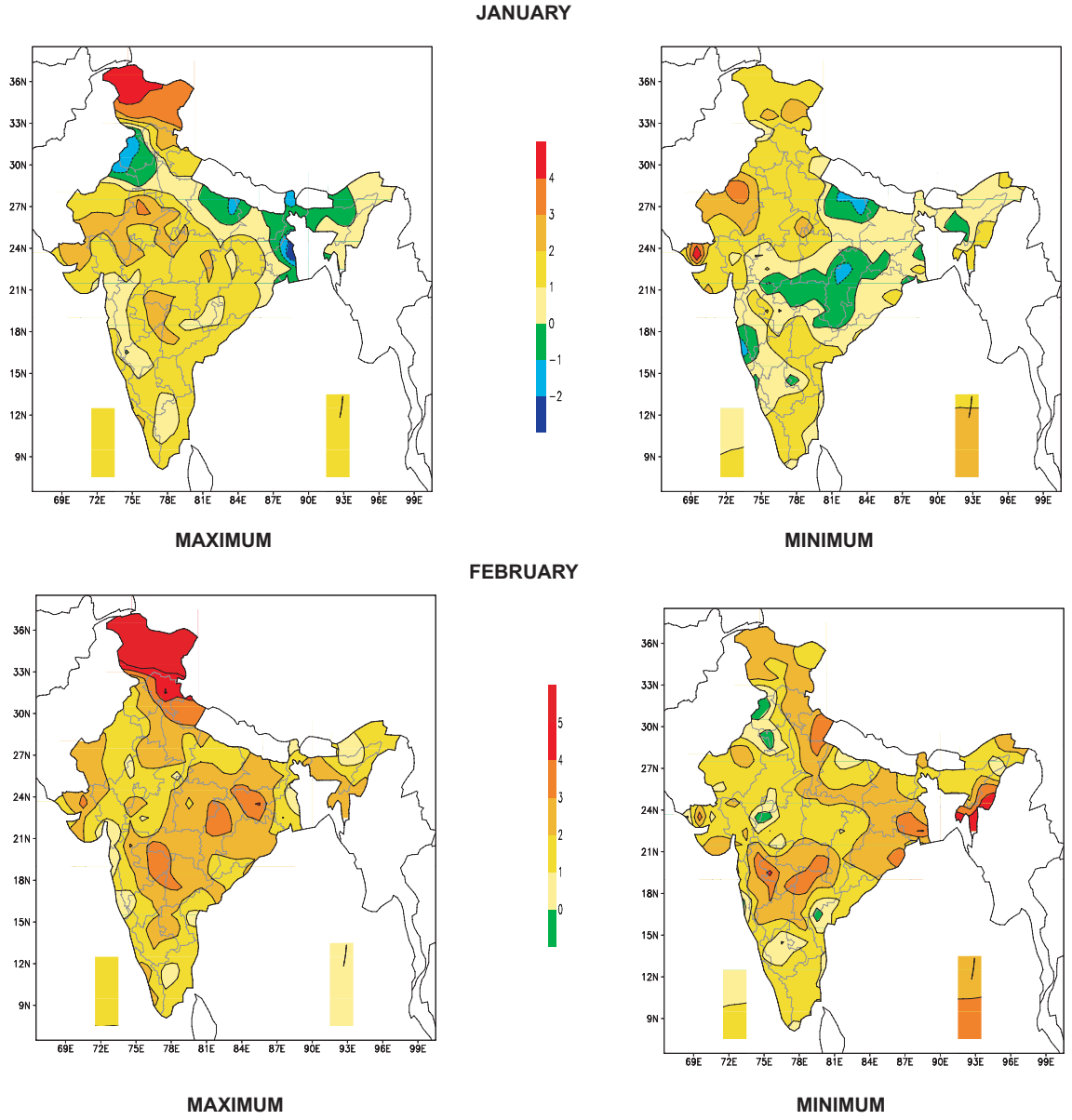
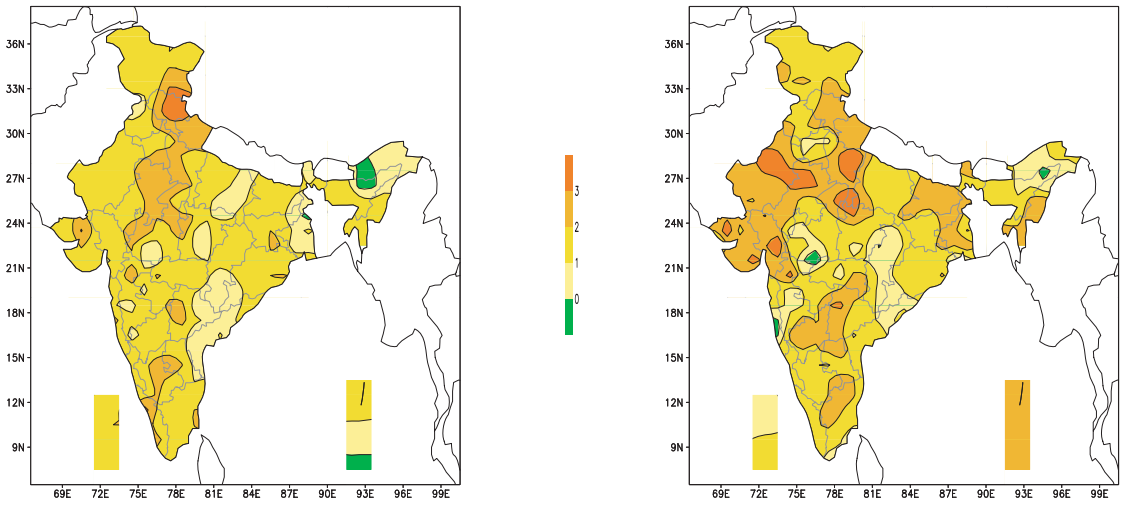


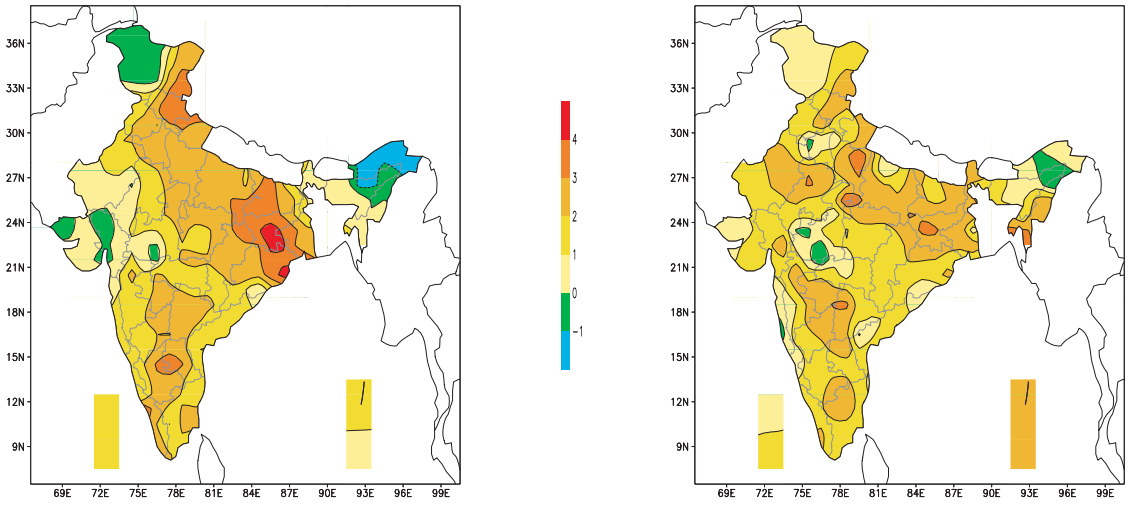
FIG. 4 : MONTHLY MEAN MAXIMUM AND MINIMUM TEMPERATURE ANOMALIES(°C) IN 2016 WITH RESPECT TO 1971 - 2000 AVERAGE

MARCH



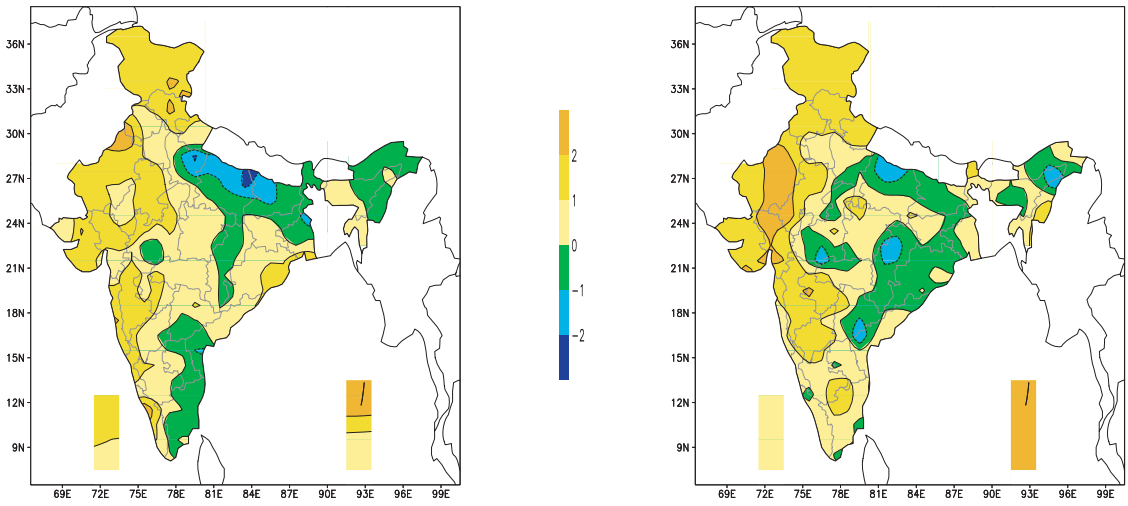
MAXIMUM MINIMUM

APRIL



MAXIMUM MINIMUM

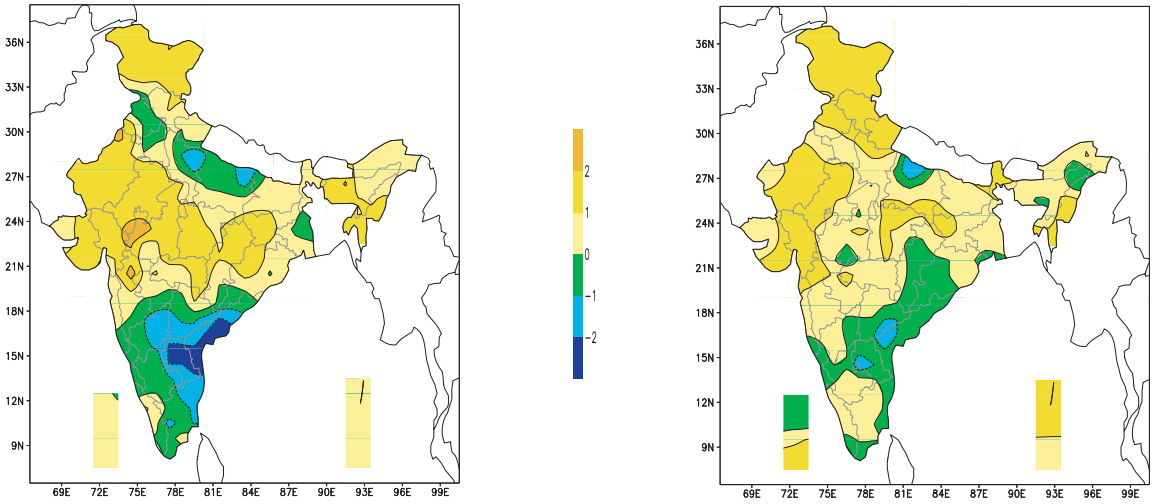
MAY



MAXIMUM MINIMUM

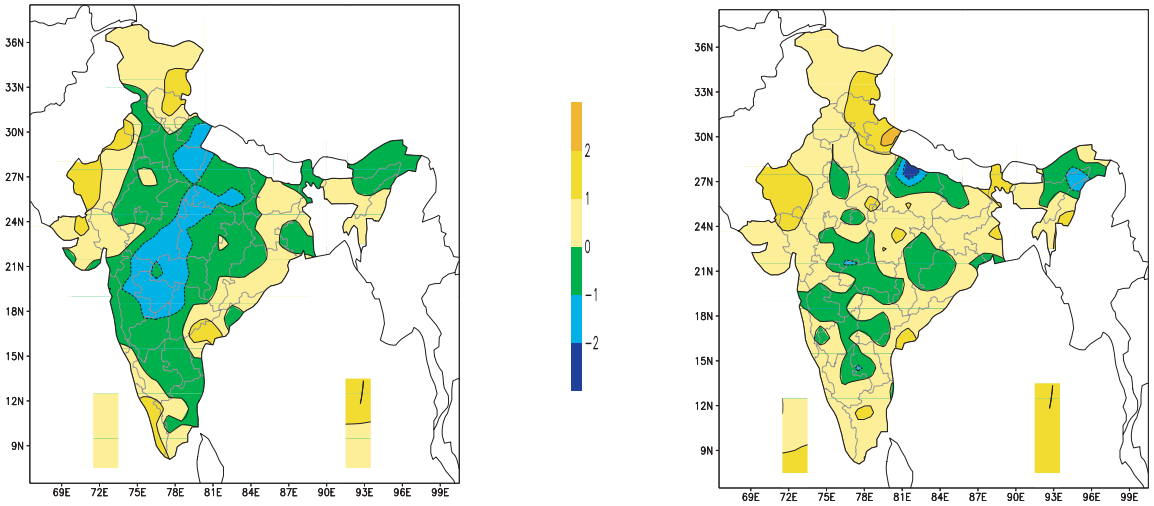
FIG. 4 : Contd...

JUNE



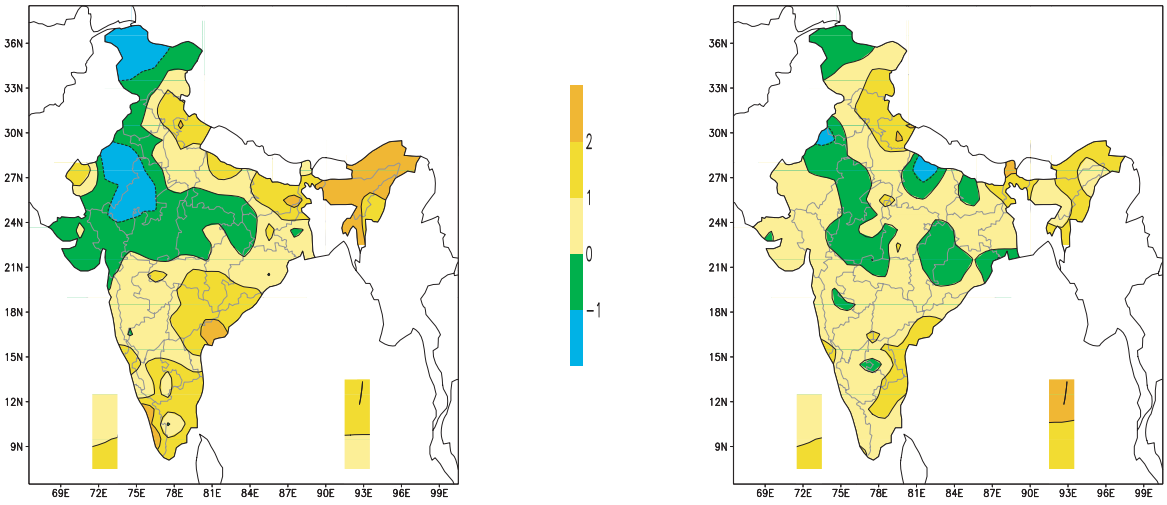
MAXIMUM **MINIMUM**

JULY



MAXIMUM **MINIMUM**

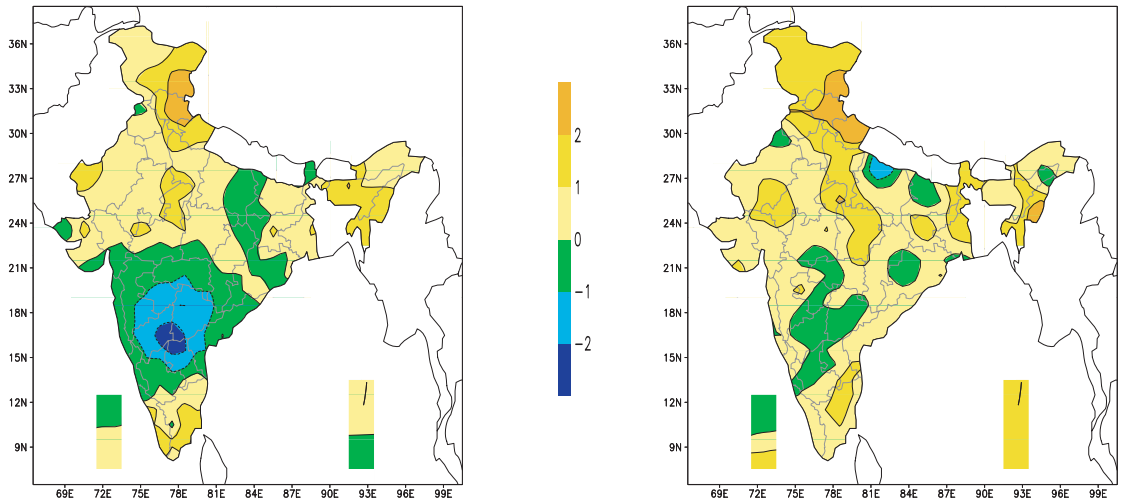
AUGUST



MAXIMUM **MINIMUM**

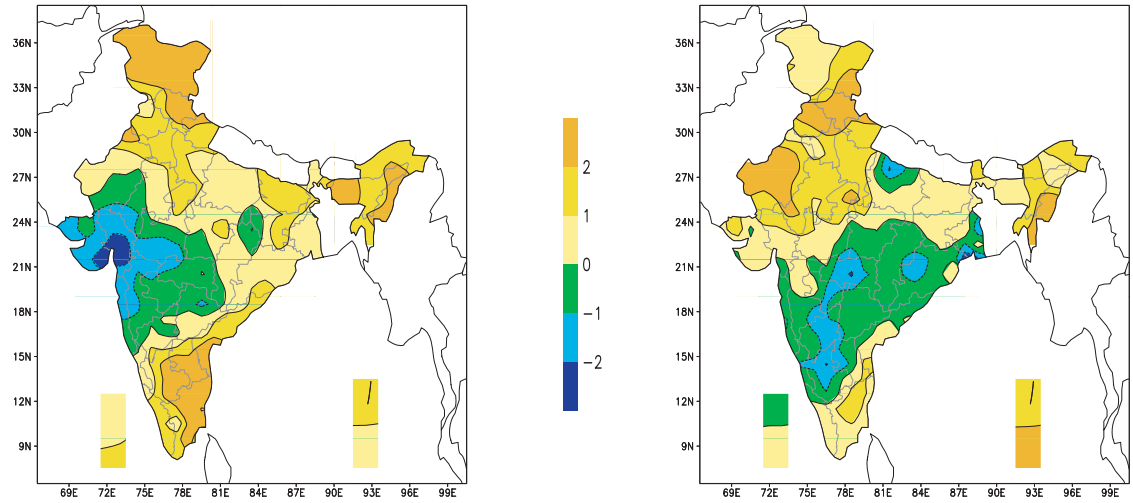
FIG. 4 : Contd..

SEPTEMBER



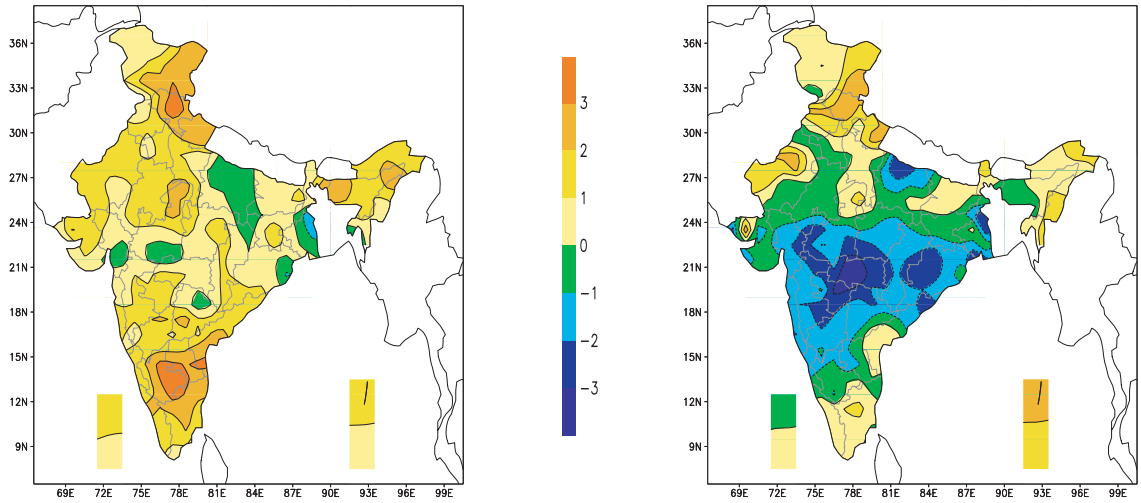
MAXIMUM **MINIMUM**

OCTOBER



MAXIMUM **MINIMUM**

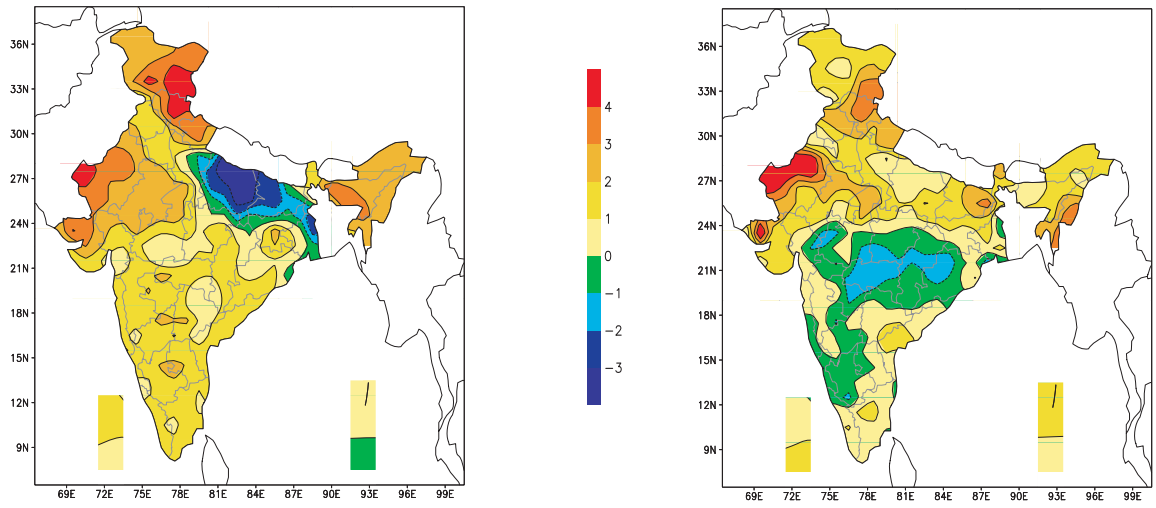
NOVEMBER



MAXIMUM **MINIMUM**

FIG. 4 : Contd..

DECEMBER



MAXIMUM **MINIMUM**

FIG. 4 : Contd..



FIG. 5 : MEAN MONTHLY (a) MINIMUM AND (b) MAXIMUM TEMPERATURE ANOMALIES (2012 - 2016)

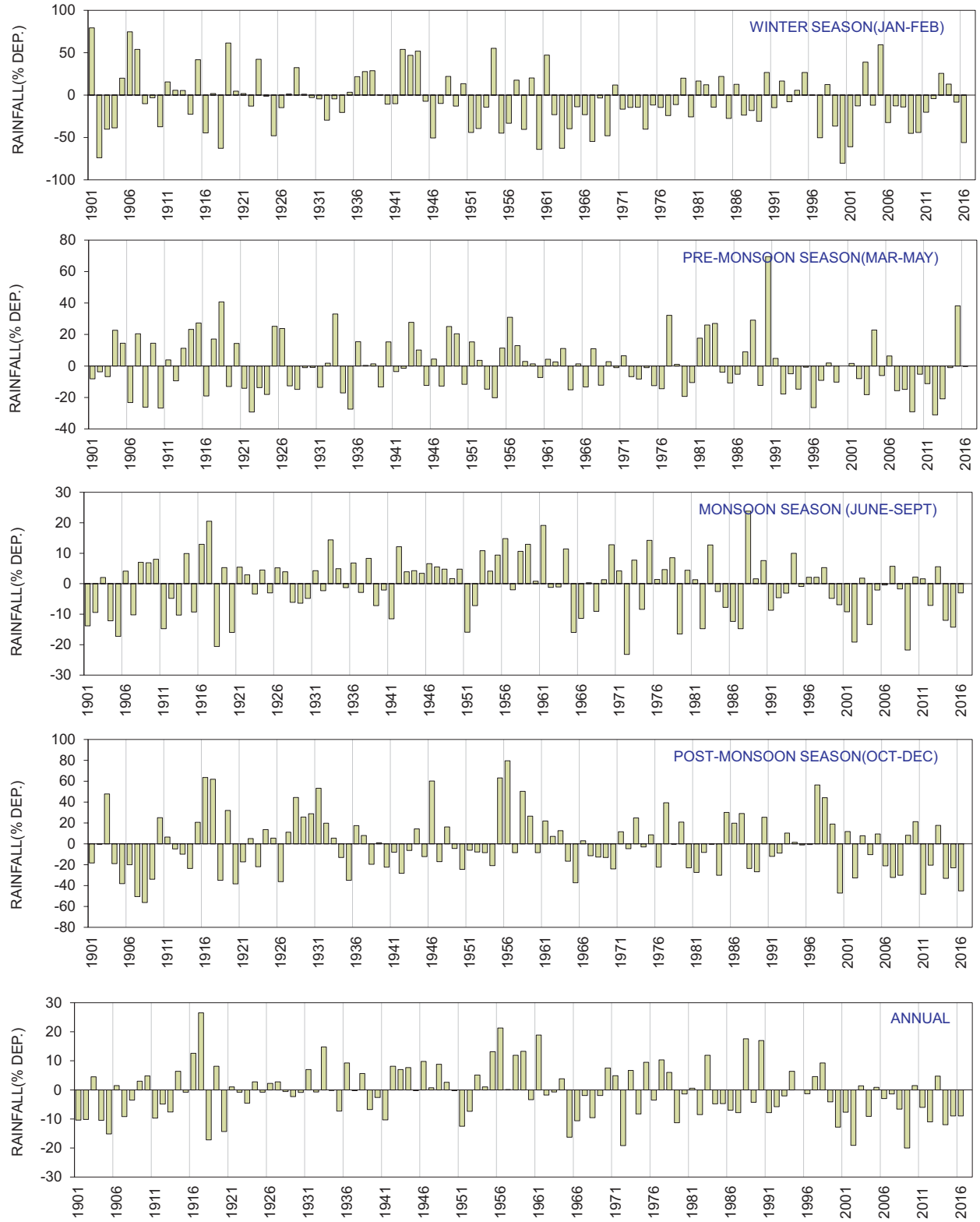
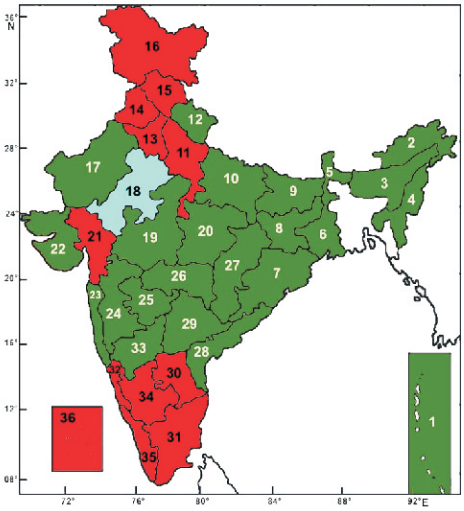
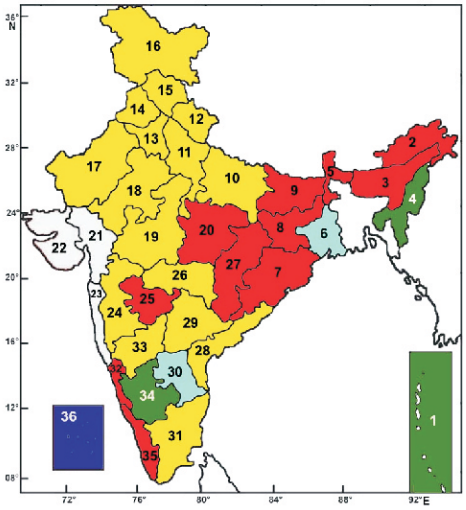


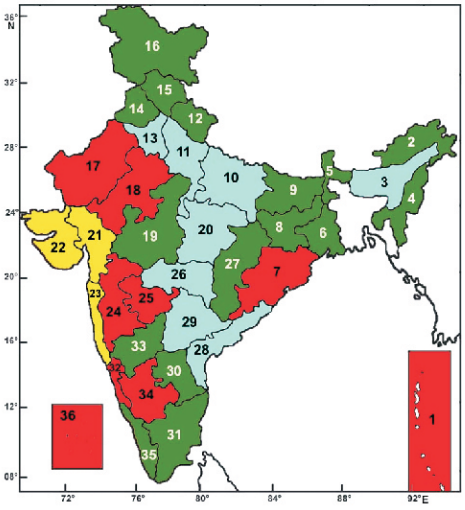
FIG. 6 : PERCENTAGE DEPARTURE OF AREA WEIGHTED SEASONAL AND ANNUAL RAINFALL OVER THE COUNTRY AS A WHOLE (1901-2016)



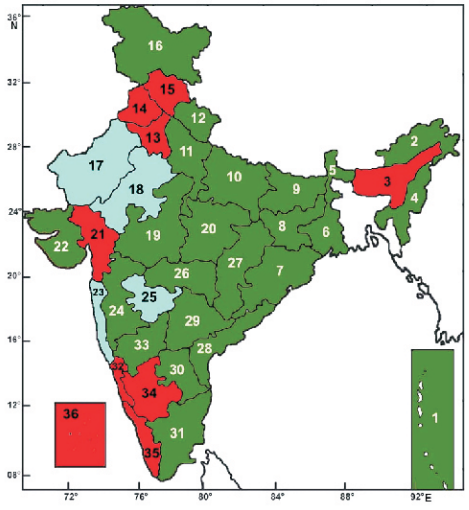
ANNUAL



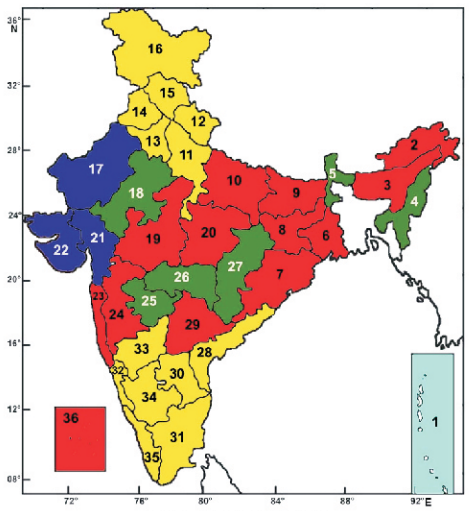
WINTER



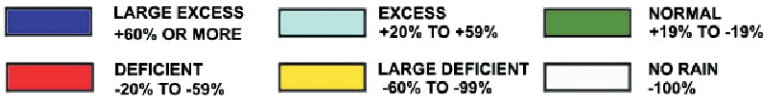
PRE-MONSOON



MONSOON



POST-MONSOON



(Figures indicates subdivision numbers)

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

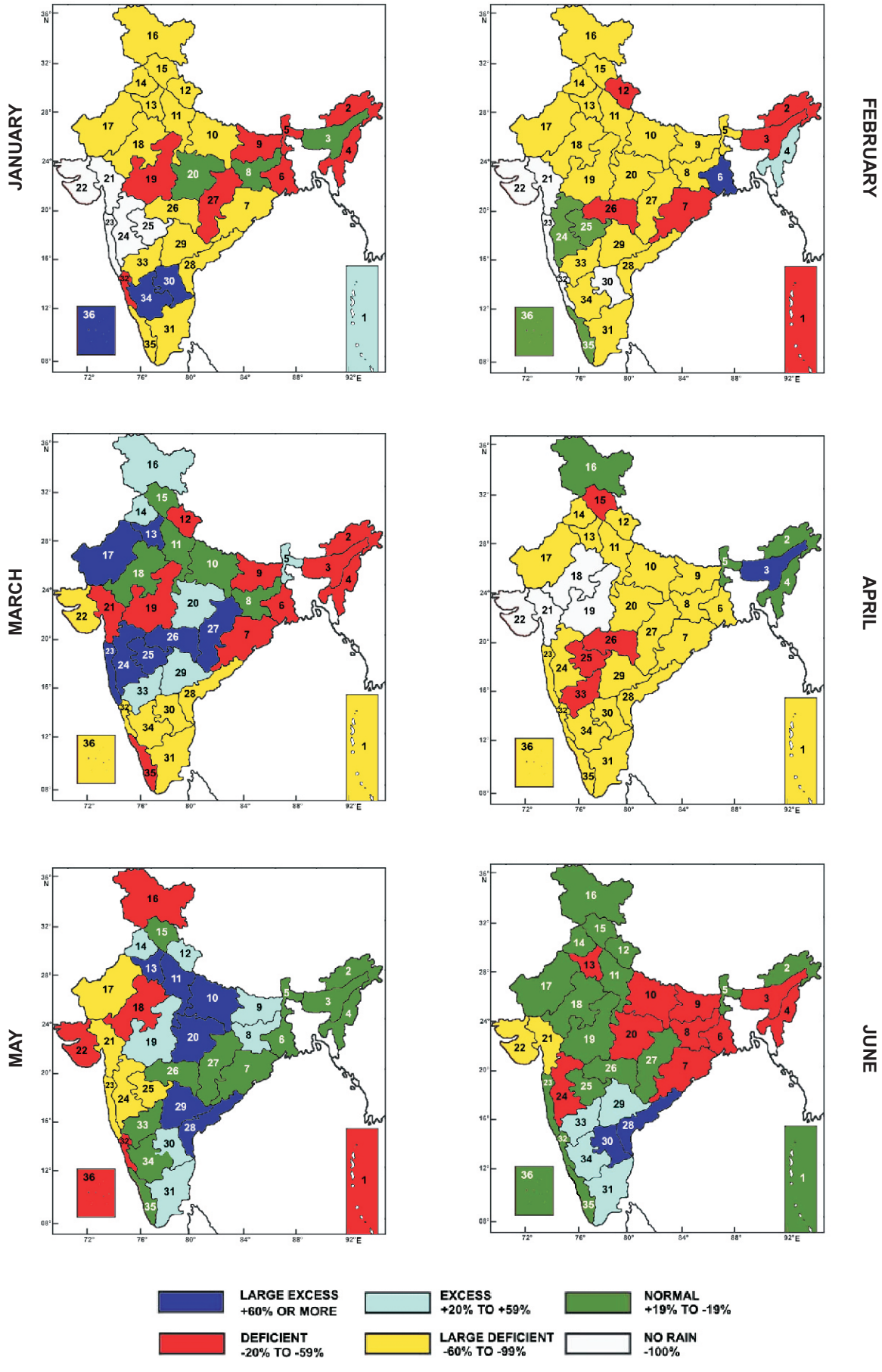


FIG.8 : SUB-DIVISIONWISE MONTHLY RAINFALL PERCENTAGE DEPARTURES FOR 2016

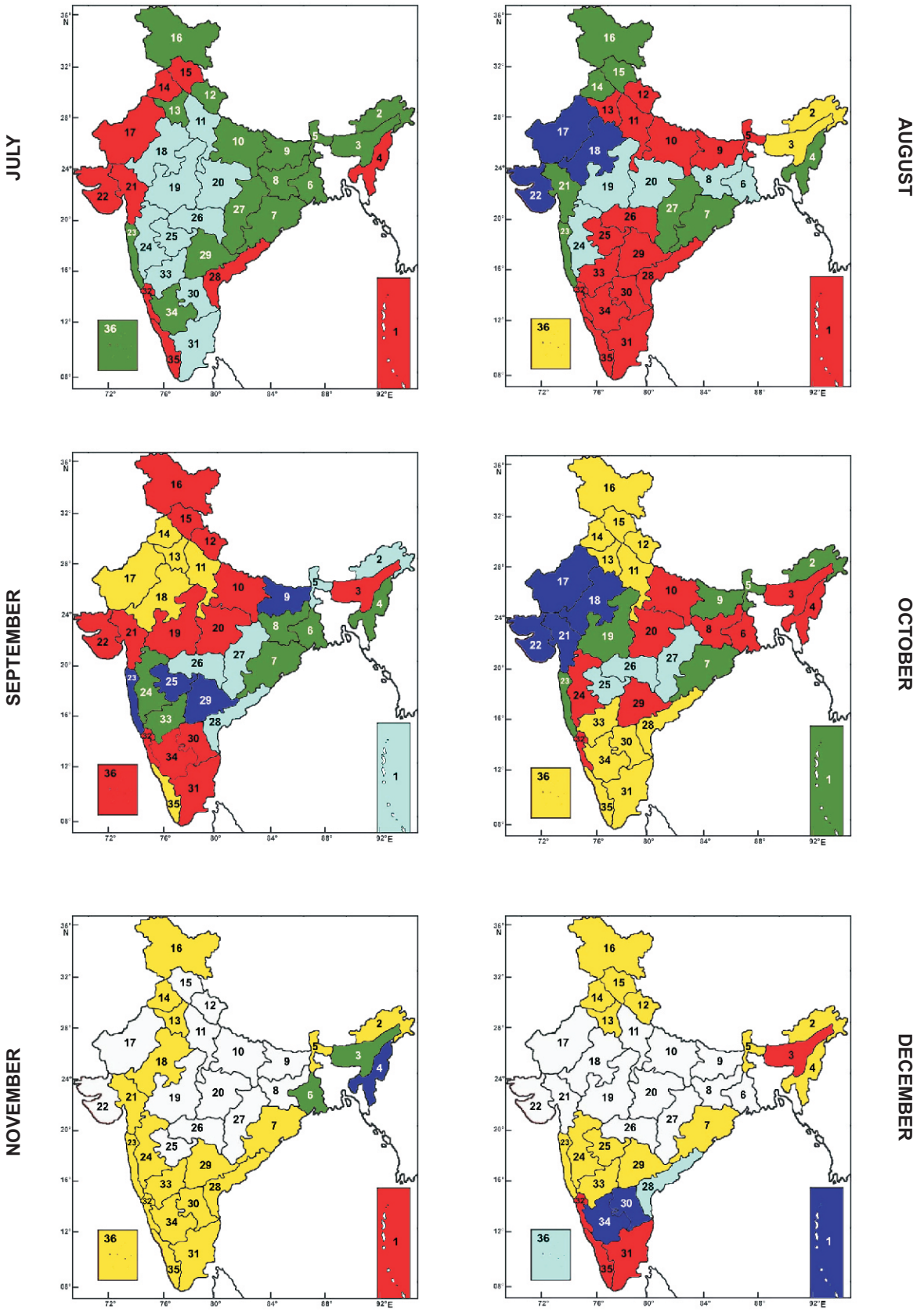

JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
LARGE EXCESS
+60% OR MORE
EXCESS
+20% TO +59%
NORMAL
+19% TO -19%
DEFICIENT
-20% TO -59%
LARGE DEFICIENT
-60% TO -99%
NO RAIN
-100%

FIG.8 : Contd.....

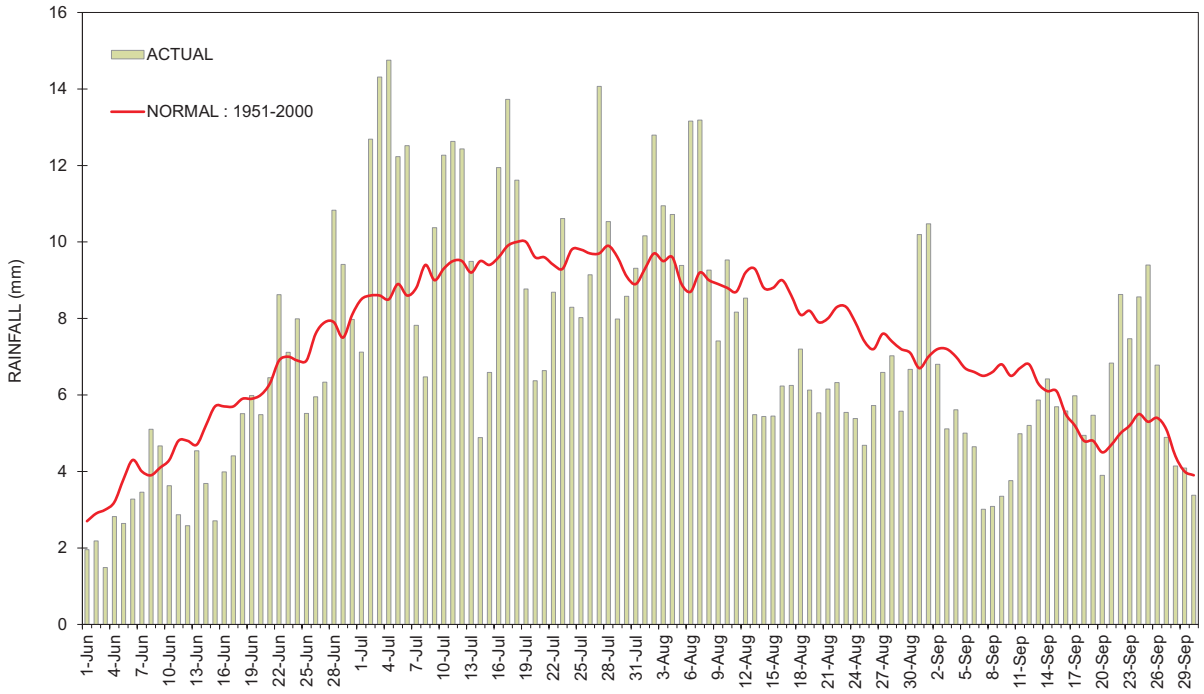


FIG. 9 : DAILY AREA WEIGHTED RAINFALL (mm) OVER THE COUNTRY AS A WHOLE (VERTICAL BARS) AND ITS LONG TERM AVERAGE (1951-2000) (CONTINUOUS LINE) 1 JUNE - 30 SEPTEMBER 2016

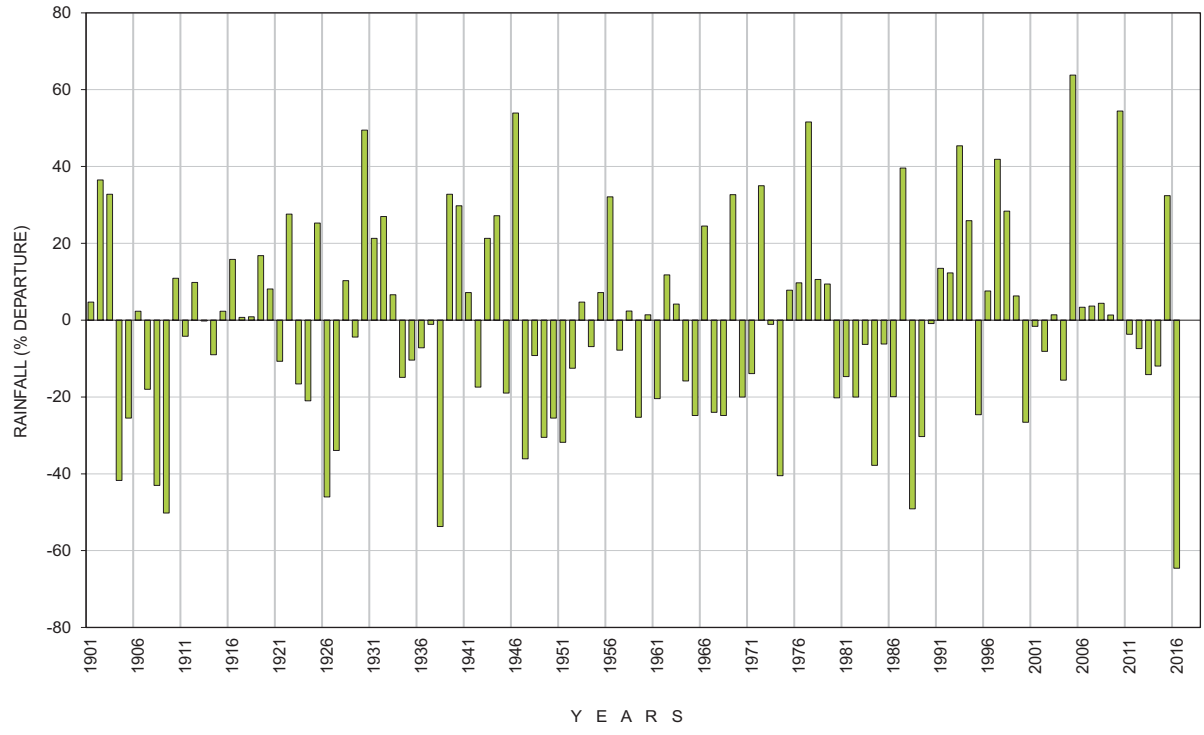


FIG. 10 : PERCENTAGE DEPARTURE OF RAINFALL DURING THE POST-MONSOON SEASON (OCTOBER TO DECEMBER) OVER THE SOUTH PENINSULA (1901-2016)

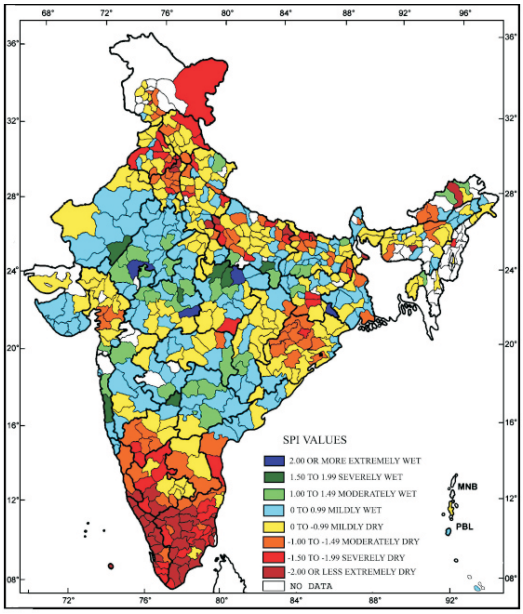


FIG. 11 : STANDARDIZED PRECIPITATION INDEX JAN - DEC 2016

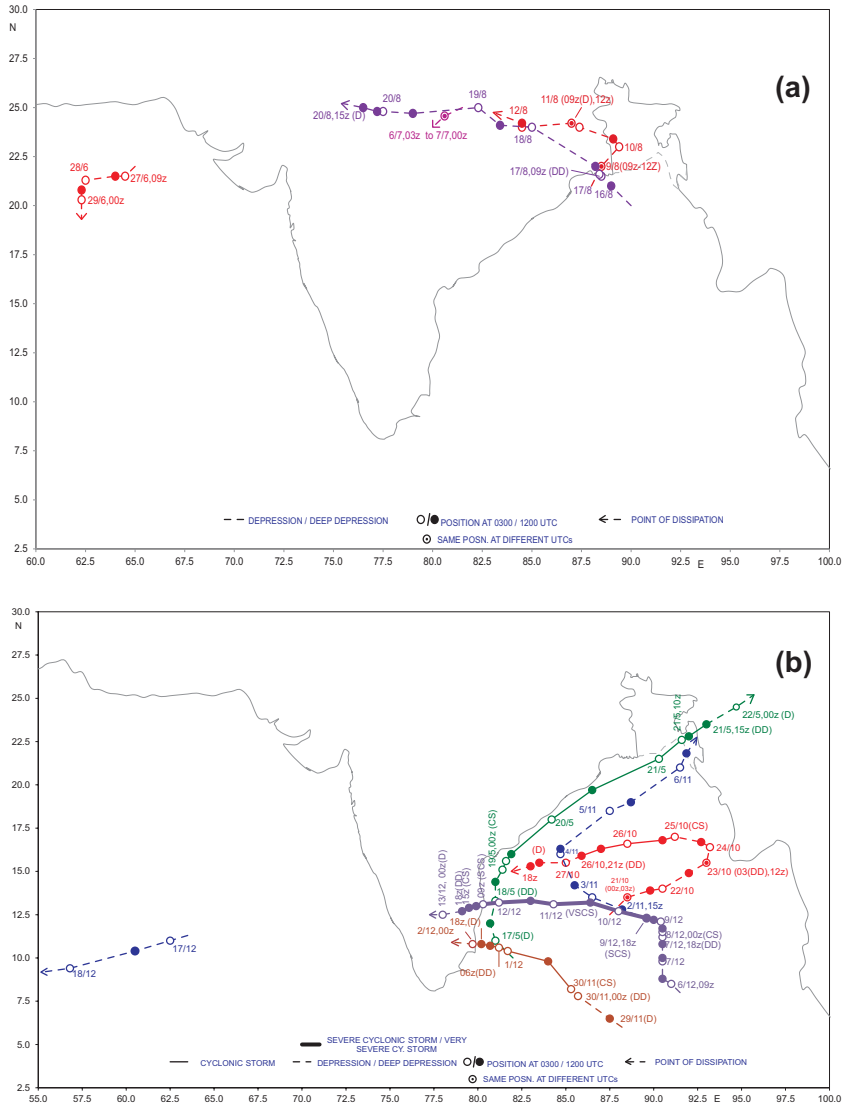
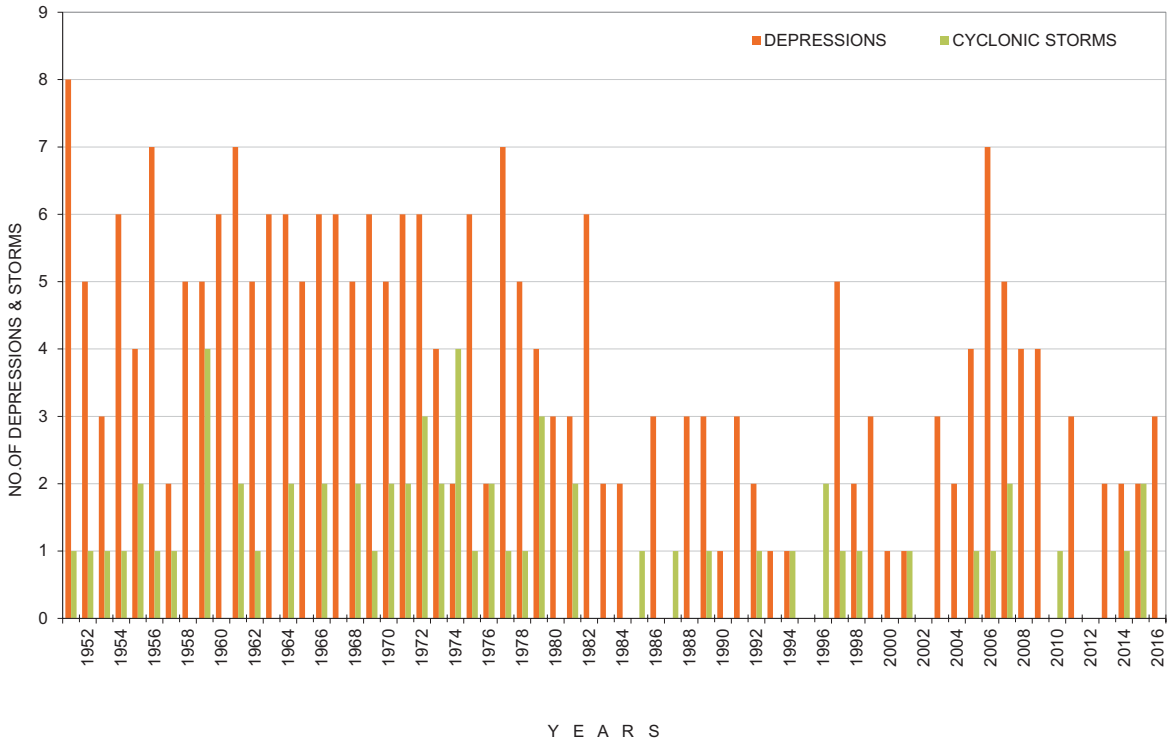
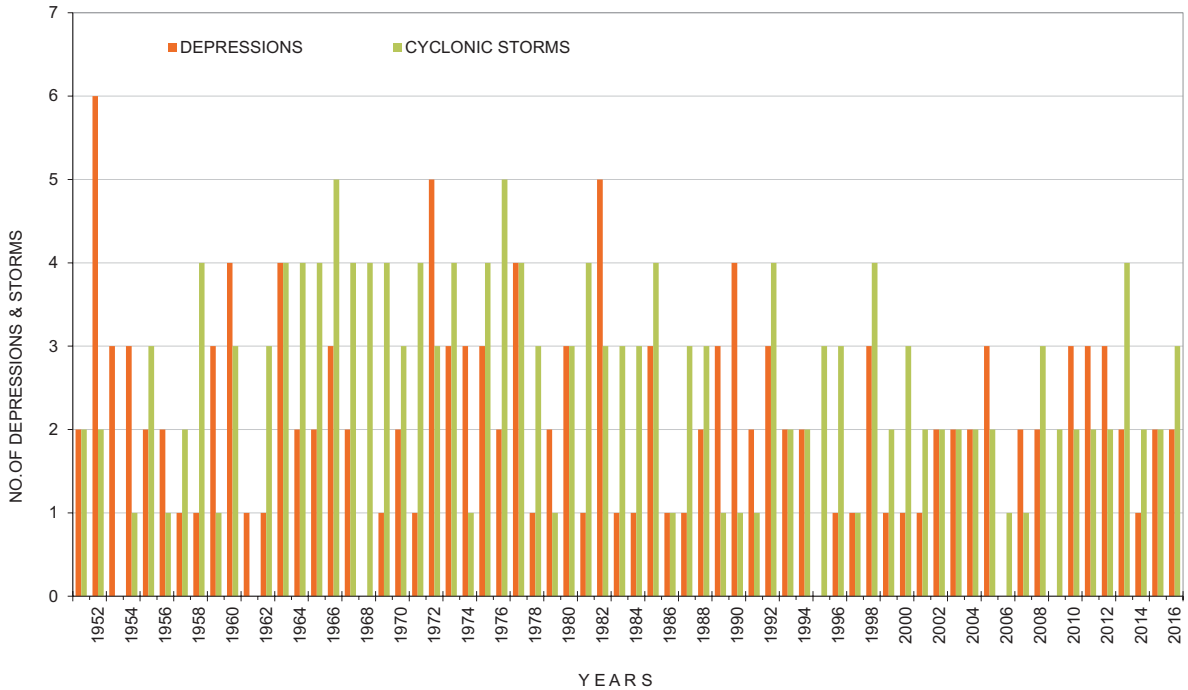


FIG. 12 : TRACKS OF DEPRESSIONS AND CYCLONIC STORMS FORMED DURING 2016
a) MONSOON SEASON b) OTHER SEASONS



(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 (1951-2016)

(a) 22 - 26 JANUARY

(b) 20 - 24 DECEMBER

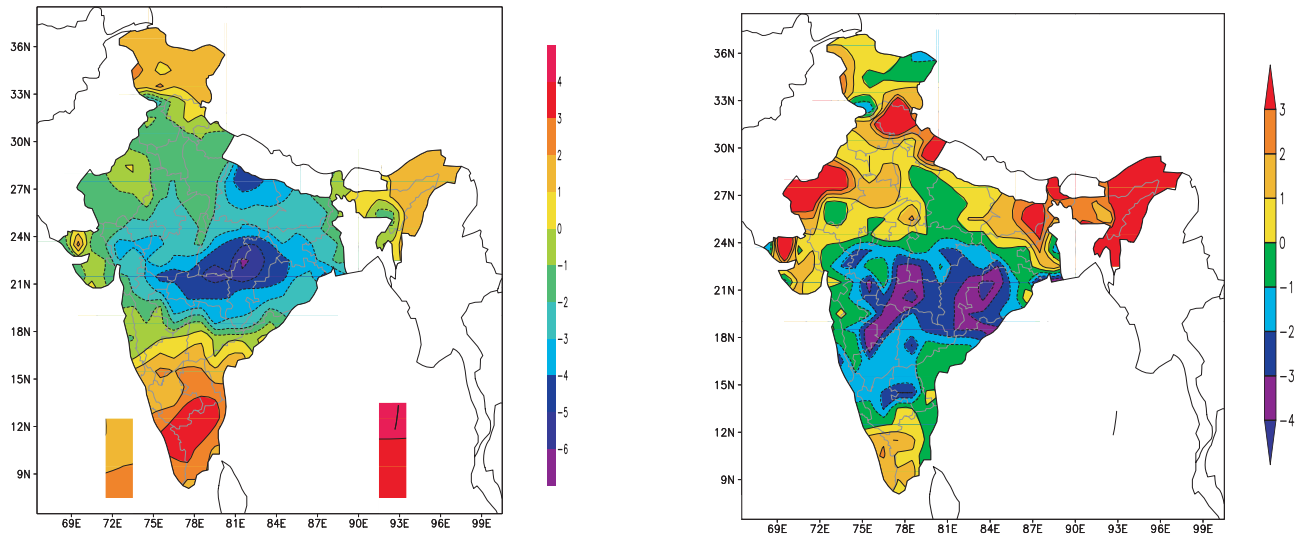


FIG. 14: MINIMUM TEMPERATURE ANOMALY (°C) DURING THE COLD WAVE PERIOD
(WITH RESPECT TO 1971 - 2000 AVERAGE)

(a) 20 - 24 APRIL

(b) 18 - 22 MAY

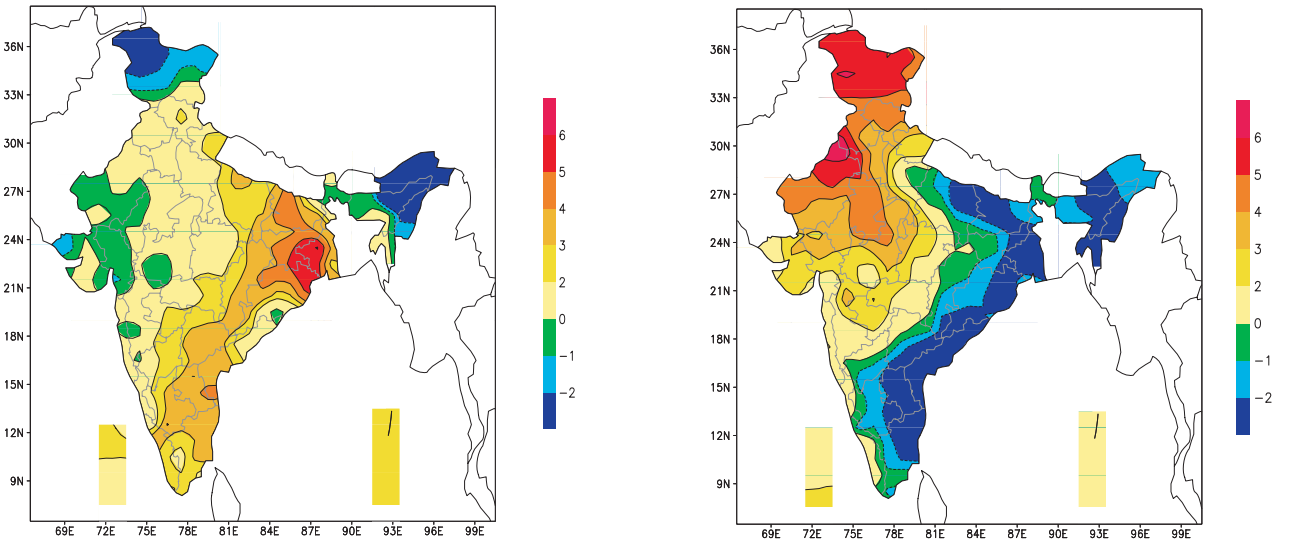


FIG. 15: MAXIMUM TEMPERATURE ANOMALY (°C)DURING THE HEAT WAVE PERIOD
(WITH RESPECT TO 1971 - 2000 AVERAGE)

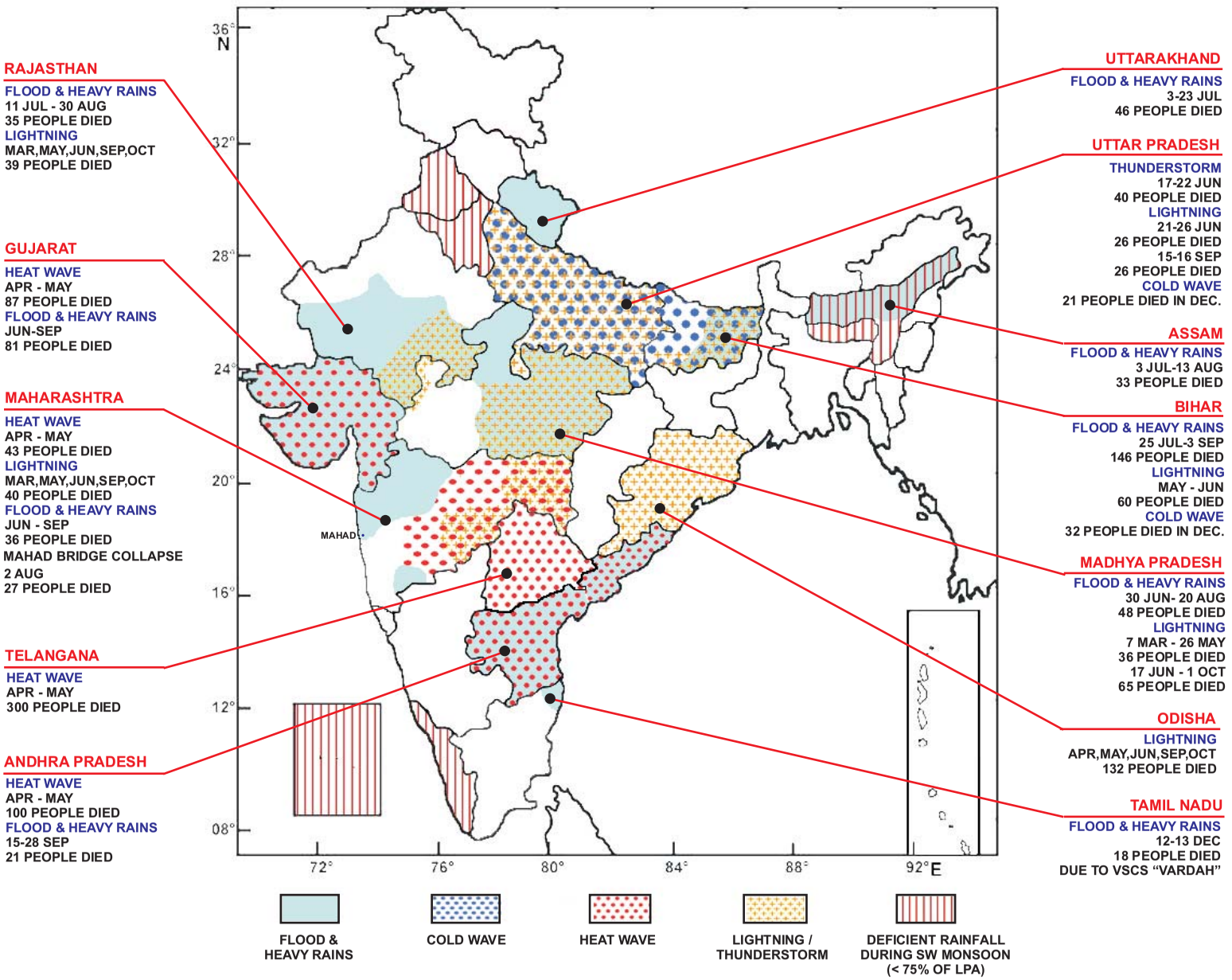


FIG.16 : SIGNIFICANT WEATHER EVENTS DURING 2016

TABLE - 1

METEOROLOGICAL SUB-DIVISION WISE SEASONAL AND ANNUAL RAINFALL STATISTICS FOR THE YEAR 2016 BASED ON OPERATIONAL DATA

S.NO.	SUBDIVISION NAME	WINTER SEASON			PRE-MONSOON			MONSOON			POST MONSOON SEASON			ANNUAL 2016		
		ACTUAL	NORMAL	%DEP	ACTUAL	NORMAL	%DEP	ACTUAL	NORMAL	%DEP	ACTUAL	NORMAL	%DEP	ACTUAL	NORMAL	%DEP
1	A & N ISLANDS	87.8	82.9	6	198.9	465.0	-57	1562.6	1682.5	-7	1002.6	695.9	44	2851.9	2926.3	-3
2	ARUNACHAL PRADESH	103.6	148.1	-30	693.3	750.4	-8	1699.1	1768.0	-4	189.6	267.2	-29	2685.6	2933.7	-8
3	ASSAM & MEGHALAYA	34.6	46.9	-26	734.4	590.2	24	1249.0	1792.8	-30	153.9	195.0	-21	2171.9	2624.9	-17
4	NAG.,MANI.,MIZO.,TRIP	45.5	44.0	3	574.8	494.1	16	1244.0	1496.9	-17	204.2	243.0	-16	2068.5	2278.0	-9
5	S.H.W.B. & SIKKIM	27.9	60.3	-54	434.0	457.1	-5	1996.2	2006.2	0	155.7	185.3	-16	2613.7	2708.9	-4
6	GANGATIC W.B.	47.3	34.4	37	133.2	164.8	-19	1162.9	1167.9	0	88.6	160.1	-45	1432.0	1527.2	-6
7	ODISHA	18.8	31.8	-41	98.0	134.7	-27	1030.8	1149.9	-10	104.4	144.1	-28	1252.1	1460.5	-14
8	JHARKHAND	18.4	33.4	-45	84.4	79.4	6	1096.9	1091.9	0	45.5	91.6	-50	1245.2	1296.3	-4
9	BIHAR	9.9	23.0	-57	85.1	77.5	10	994.1	1027.6	-3	60.8	77.5	-22	1149.8	1205.6	-5
10	EAST U.P.	6.6	28.9	-77	47.6	31.7	50	790.3	897.6	-12	25.9	60.4	-57	870.5	1018.6	-15
11	WEST U.P.	4.0	33.3	-88	38.9	29.1	34	640.1	769.4	-17	9.6	54.4	-82	692.6	886.2	-22
12	UTTARAKHAND	34.6	106.2	-67	154.1	156.0	-1	1104.2	1229.1	-10	16.5	89.6	-82	1309.4	1580.9	-17
13	HAR., CHANDI. & DELHI	1.2	32.9	-96	48.1	34.2	41	338.3	466.3	-27	6.2	29.4	-79	393.7	562.8	-30
14	PUNJAB	12.5	49.5	-75	60.2	53.5	13	352.0	491.9	-28	3.4	41.0	-92	428.1	635.9	-33
15	HIMACHAL PRADESH	57.1	195.5	-71	233.8	244.9	-5	624.5	825.3	-24	7.5	108.2	-93	922.8	1373.9	-33
16	JAMMU & KASHMIR	78.8	212.9	-63	331.8	326.0	2	481.8	534.6	-10	9.4	131.8	-93	901.8	1205.3	-25
17	WEST RAJASTHAN	1.7	7.4	-77	9.9	19.1	-48	315.8	263.2	20	18.1	9.5	91	345.5	299.2	15
18	EAST RAJASTHAN	1.0	10.5	-91	11.9	17.4	-32	812.7	615.8	32	32.6	27.6	18	858.2	671.3	28
19	WEST M.P.	5.2	13.6	-62	12.8	13.5	-5	1040.0	876.1	19	40.6	53.1	-24	1098.6	956.3	15
20	EAST M.P.	22.3	35.3	-37	36.2	25.1	44	1249.4	1051.2	19	29.0	57.8	-50	1337.0	1169.4	14
21	GUJARAT REG. & DDNH	0.0	1.1	-100	1.00	6.4	-84	694.6	914.7	-24	66.9	34.5	94	762.6	956.7	-20
22	SAURASHTRA & KUTCH	0.0	0.6	-100	1.3	3.9	-66	416.9	477.5	-13	64.7	29.5	119	482.9	511.5	-6
23	KONKAN & GOA	0.0	0.3	-100	5.0	37.0	-86	3549.8	2914.7	22	108.3	149.1	-27	3663.1	3101.1	18
24	MADHYA M'RASHTRA	0.7	1.9	-61	15.8	37.8	-58	819.3	729.3	12	64.1	107.8	-41	899.9	876.8	3
25	MARATHAWADA	2.9	6.8	-57	20.1	30.3	-34	824.8	682.9	21	100.9	101.6	-1	948.6	821.6	15
26	VIDARBHA	5.9	17.2	-66	37.5	30.9	21	1044.8	954.6	9	75.0	81.8	-8	1163.2	1084.5	7
27	CHATTISGARH	9.1	21.3	-57	45.2	45.2	0	1176.0	1153.3	2	79.8	78.0	2	1310.2	1297.8	1
28	COASTAL A.P.	2.6	18.7	-86	133.2	97.0	37	662.9	581.1	14	109.4	327.4	-67	908.1	1024.2	-11
29	TELANGANA	1.4	11.3	-88	70.6	56.8	24	899.8	755.2	19	71.3	119.3	-40	1043.0	942.6	11
30	RAYALASEEMA	8.1	6.6	22	81.8	82.0	0	392.2	398.3	-2	73.9	219.2	-66	555.9	706.1	-21
31	TAMIL NADU & PUDU.	3.3	30.9	-89	111.6	128.1	-13	258.1	317.2	-19	166.0	438.2	-62	539.0	914.4	-41
32	COASTAL KARNATAKA	0.5	0.9	-47	103.8	178.8	-42	2428.8	3083.8	-21	98.3	262.8	-63	2631.4	3526.3	-25
33	N.I.KARNATAKA	0.9	3.9	-77	68.5	85.1	-19	525.7	506.0	4	33.0	145.3	-77	628.1	740.3	-15
34	S.I.KARNATAKA	4.2	4.4	-4	107.3	145.2	-26	524.5	660.0	-21	62.8	209.6	-70	698.9	1019.2	-31
35	KERALA	19.4	24.3	-20	315.3	379.7	-17	1352.2	2039.6	-34	185.3	480.7	-61	1872.1	2924.3	-36
36	LAKSHADWEEP	71.7	35.5	102	96.7	232.4	-58	745.5	998.5	-25	165.4	333.6	-50	1079.2	1600.0	-33

TABLE - 2

STATION WISE TEMPERATURE AND RAINFALL EXTREMES FOR THE YEAR 2016

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	6.8	1_26	37.3	5_11	154.4	5_22
2	Cherrapunji*	3.7	1_26	30.2	8_26	447.8	7_19
3	Dibrugarh AP	6.6	12_30	37.5	8_3	66.4	6_30
4	Guwahati AP	8.2	1_15	38.4	8_25	114.5	6_18
5	Imphal AP	3.2	1_24	34.5	8_25	94.0	5_22
6	Passighat	11.4	1_28	37.0	8_3	264.7	9_2
7	Shillong*	2.2	1_26	28.3	8_4	83.8	7_19
8	Tezpur	10.0	1_18	36.8	8_3	78.6	5_17
9	Baghdogra AP	4.7	1_25	38.7	3_29	279.8	7_24
10	Berhampore	9.0	1_26	42.6	4_11	63.0	7_5
11	Kolkata	11.3	1_25	41.3	4_11	131.9	9_6
12	Cooch Behar AP	7.2	1_29	37.5	8_25	218.0	6_25
13	Contai	7.8	1_26	41.5	4_11	125.5	8_4
14	Darjeeling*	0.6	1_11	40.0	4_25	95.1	6_14
15	Gangtok*	3.3	1_26	26.3	8_27	127.4	5_15
16	Jalpaiguri	7.6	1_26	37.9	4_8	146.8	7_25
17	Kalimgpong*	4.0	1_22,23,28	29.5	6_3	125.0	7_10
18	Krishnanagar	8.0	1_25	41.8	4_22, 23	133.2	8_11
19	Midnapore	9.5	1_25	45.0	4_23	70.6	8_22
20	Panagarh	7.0	1_24	44.5	4_23	197.2	8_22
21	Balasore	10.2	1_25	44.2	4_23	90.0	8_17
22	Bhubaneshwar AP	12.3	12_22	45.8	4_11	69.2	6_27
23	Chandbali	11.6	1_24	44.4	4_11	168.2	8_17
24	Gopalpur	13.5	1_24	37.0	4_30	79.0	5_20
25	Jharsugda AP	6.6	1_24	45.5	4_17, 5_23	70.6	9_11
26	Puri	13.4	1_24	38.0	5_5	118.0	1_21
27	Sambalpur	7.5	12_22	45.2	4_22	240.3	8_4
28	Daltonganj	5.5	1_24	45.0	5_2	142.8	8_12
29	Gaya AP	5.7	1_24	44.5	5_18	237.8	9_6
30	Jamshedpur AP	7.6	1_24	45.8	4_23	239.2	8_18
31	Patna AP	4.8	1_23	44.5	4_30	133.8	9_12
32	Purnea	4.8	1_24	41.3	4_25	102.3	5_19
33	Ranchi AP	5.5	1_25	42.0	4_27	117.7	7_4
34	Bahraich	1.4	1_23	43.0	4_27	200.6	7_2
35	Bareilly	4.9	1_23	42.5	4_27, 5_16, 17	112.6	7_25
36	Dehar Dun	3.6	1_21	40.2	5_17	92.5	8_8
37	Gorakhpur	2.8	1_23	43.0	4_20	94.6	7_19
38	Jhansi	4.3	1_22	46.4	5_18	123.0	7_27
39	Lucknow AP	2.1	1_23	44.4	5_16	91.3	8_15
40	Mukteshwar**	-2.0	1_20	29.2	5_17	117.6	7_17
41	Varansai	4.7	1_23	45.1	5_16	70.6	8_8
42	Ambala	4.5	1_23	43.7	5_2, 18	84.6	8_10
43	Chandigarh	0.7	1_24	43.6	5_18	61.1	8_22
44	Hissar	3.2	2_10	47.8	5_21	93.1	6_14
45	Karnal	4.0	2_4	43.8	5_18	84.0	8_8
46	New Delhi AP	4.2	1_22	44.0	5_2	63.5	9_1
47	Amritsar AP	1.4	1_24	45.0	5_18	84.7	7_16
48	Patiala	4.6	1_27	44.4	5_18	51.8	7_2
49	Shimla*	-0.2	1_20	29.8	5_2	76.1	8_1
50	Banihal*	-0.8	1_23 , 12_17	33.5	6_24	69.2	3_19
51	Gulmarg*	-11.2	1_7	25.4	7_1	44.2	3_18
52	Jammu AP	0.5	1_24	43.3	6_4	127.6	8_7
53	Srinagar*	-6.5	12_21	34.4	6_30	52.8	3_19
54	Ajmer	6.8	1_21 , 22	46.2	5_19	80.6	7_25
55	Barmer	7.3	1_22	49.5	5_19	38.3	8_9
56	Bikaner	5.2	1_22	49.5	5_19	43.7	8_8
57	Ganganagar	3.7	12_27	49.2	5_21	90.6	7_28
58	Jaipur AP	4.0	1_16	46.5	5_19	63.8	7_2
59	Jaisalmer	5.4	1_20	49.0	5_19	90.2	8_28
60	Jodhpur AP	5.4	1_22, 23	48.8	5_19	172.2	8_10
61	Kota AP	6.5	1_22	48.2	5_19, 20	193.1	8_7
62	Udaipur	3.8	1_22	46.4	5_19	98.1	7_4
63	Ambikapur	3.2	1_23	42.4	4_19, 20	126.4	8_13
64	Betul	4.0	1_22	44.6	5_18	146.2	7_9
65	Bhopal(AP)	6.0	1_21	46.7	5_20	175.4	7_9
66	Guna	3.4	1_21	46.7	5_20	133.6	7_6
67	Gwalior	3.5	1_22	47.0	5_19	65.3	7_27
68	Indore(AP)	7.3	1_23	44.5	5_18	60.0	7_10
69	Jabalpur	5.0	1_23	44.5	5_15	109.6	7_8
70	Jagdalpur	7.2	12_19, 23, 24	42.4	5_31	154.5	6_28
71	Khandwa	6.0	1_24	45.1	5_13	108.0	7_10
72	Nowgong	4.0	1_22	47.0	5_18	208.0	8_19
73	Pendra	2.5	1_23	42.0	4_16, 17, 19, 20	78.3	9_26
74	Ratlam	5.0	1_21	46.2	6_5	198.0	8_21
75	Sagar	7.2	1_21	46.4	5_20	164.2	8_20

TABLE - 2 (CONTD.)

S.NO.	STATION NAME	MIN (^{0}C)	DATE (MONTH_DATE)	MAX (^{0}C)	DATE (MONTH_DATE)	HIGHEST 24 Hr. RAINFALL(mm)	DATE (MONTH_DATE)
76	Satna	4.9	1_23	45.9	5_14	277.4	7_7
77	Seoni	5.4	1_23	44.0	5_16, 21, 23	141.8	7_11
78	Umaria	2.6	1_23	45.0	5_16	120.4	8_17
79	Ahmedabad AP	7.5	1_25	48.0	5_19	104.8	8_5
80	Baroda	9.4	1_25	44.6	5_18	144.2	8_10
81	Bhavnagar AP	10.9	1_22	44.0	5_21	93.4	9_19
82	Bhuj AP	11.5	1_21	45.6	5_18	56.8	10_4
83	Deesa	8.1	1_23	48.0	5_19	83.0	8_24
84	Dwarka	14.0	1_24	37.4	3_22	90.8	8_7
85	Naliya	5.4	1_21	37.7	6_30	74.2	8_6
86	New Kandala	11.0	1_22	43.6	5_19	32.6	8_6
87	Porbandar AP	9.8	1_25	39.6	3_27	77.5	8_5
88	Rajkot AP	11.2	1_25	46.0	5_19	113.6	8_6
89	Surat	11.5	1_26	41.8	5_17	126.4	7_4
90	Veraval	14.5	1_20, 25	38.5	3_23	78.6	6_26
91	Akola	7.9	1_22	47.1	5_18	84.3	7_11
92	Ahmadnagar	5.6	12_10	43.3	4_16	78.2	9_15
93	Aurangabad AP	8.1	12_28	43.8	5_18	97.7	7_11
94	Buldhana	10.4	12_28	43.5	5_18	58.0	7_11
95	Chandrapur	8.3	1_24	46.8	6_3	130.2	7_9
96	Dahanu	13.7	1_21	37.0	5_28	528.6	9_21
97	Harnai	15.7	2_4	38.5	3_5	361.6	6_24
98	Jalgaon	7.0	1_27	46.6	5_19	97.0	7_11
99	Kolhapur	12.9	12_10	41.1	5_17	105.0	7_11
100	Mahabaleshwar*	9.8	1_21	36.4	4_15	410.4	8_3
101	Malegaon	7.2	12_27	45.2	5_18	96.0	9_18
102	Mumbai	18.0	1_20	36.4	11_27	165.6	9_24
103	Nagpur AP	5.1	1_23	46.6	5_21	70.7	6_23
104	Panjim	17.6	12_12, 24	36.5	1_1	155.8	6_22
105	Parbhani	8.9	1_22	46.0	5_19	84.0	7_30
106	Pune	7.3	1_22	41.0	5_3	74.6	8_4
107	Ratnagiri	13.5	2_4	39.6	3_17	172.9	9_24
108	Sholapur	10.1	12_10	44.9	4_21	106.4	7_21
109	Yeotmal	10.0	12_20, 21, 23, 28	44.5	5_20	109.4	7_9
110	Anantpur	11.1	12_11	44.5	4_25	95.3	5_29
111	Hyderabad AP	10.9	12_22	43.0	4_13, 22	75.4	5_6
112	Kakinada	18.2	1_18, 12_22	44.8	5_26	173.6	5_19
113	Kalingapatnam	12.2	12_22	38.8	6_15	144.6	5_20
114	Kurnool	14.5	12_24	45.1	4_25	77.8	8_31
115	Machilipatnam	17.9	12_22	44.7	5_24	118.6	9_22
116	Nellore	19.8	12_27	44.6	4_24	82.0	12_13
117	Nizamabad	11.4	12_28	45.1	4_21	94.5	9_24
118	Ongole	18.6	12_23	44.7	4_23	144.9	9_13
119	Ramgundam	10.4	1_24	46.6	5_25	132.0	10_8
120	Visakhapatnam AP	15.2	11_26	43.4	5_23	88.0	5_19
121	Chennai AP	18.5	12_23	41.8	4_22	202.5	12_13
122	Coimbatore	16.6	1_4	39.5	5_1	68.6	10_31
123	Cuddalore	18.3	12_24	40.2	5_26	101.4	5_17
124	Kanyakumari	21.9	1_17	36.2	4_23	47.6	5_20
125	Kodaikanal*	5.9	12_7	23.8	3_27	53.5	10_14
126	Madurai AP	19.0	1_15	42.3	4_24	76.0	7_26
127	Nagapattinam	19.0	12_1	39.1	4_24	137.0	11_3
128	Palayamkottai	20.5	1_3	40.8	4_24	50.0	5_12
129	Pamban	20.2	12_1	36.3	4_26	79.6	5_16
130	Salem	15.1	11_25	41.8	4_20	44.8	10_13
131	Tiruchirapalli AP	18.8	1_3	42.4	4_24	72.6	7_18
132	Vellore	16.0	12_23	43.7	4_24	108.3	12_13
133	Bangalore*	12.0	12_11	39.2	4_24	60.8	12_13
134	Chitradurga	11.0	12_11	41.0	4_27	58.2	10_12
135	Gadag	13.0	12_10	40.5	4_26	32.1	7_28
136	Gulbarga	12.5	12_11	44.5	4_26	127.4	7_21
137	Honavar	15.5	12_11	37.6	3_3	201.6	6_29
138	Karwar	16.3	1_10	37.6	11_17	150.6	6_29
139	Mangalore AP	18.8	12_11, 1_2	37.0	2_18	119.4	6_28
140	Medikeri*	7.3	1_5	33.0	4_26	127.8	6_29
141	Mysore	9.4	1_4	39.9	4_24	78.0	7_29
142	Raichur	9.2	12_11	43.8	4_25	65.8	9_15
143	Alapuzha	20.4	1_1	37.9	4_26	150.8	6_8
144	Cochi AP	20.6	12_2	36.2	4_28	109.0	10_14
145	Kozhikode	20.6	1_3	39.2	4_30	144.7	6_2
146	Thiruvananthapuram	21.0	2_2	36.5	2_18, 3_13	128.8	5_20
147	Car Nicobar	21.0	9_7, 12_11	36.5	5_9	145.4	9_22
148	Port Blair	20.3	1_12	35.6	4_23, 5_11	212.4	12_8
149	Amini Divi	22.1	1_6, 1_2	36.9	5_6	57.9	6_9
150	Minicoy	22	1_4	39.2	4_26	47.4	7_15

(:Hill stations)*







वार्षिक जलवायु सारांश - 2016

ANNUAL CLIMATE SUMMARY - 2016

जलवायु निगरानी तथा विश्लेषण समूह
Climate Monitoring & Analysis Group

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

डिजाइन एवं मुद्रित - मुद्रण विभाग,
जलवायु अनुसंधान तथा सेवाएँ का कार्यालय
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