



Press Release  
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भारत सरकार  
Government of India  
पृथ्वी विज्ञान मंत्रालय (एम. ओ. ई. एस.)  
Ministry of Earth Sciences (MoES)  
भारत मौसम विज्ञान विभाग  
**INDIA METEOROLOGICAL DEPARTMENT**  
**Climate Research and Services (CRS)**

**Statement on Climate of India during 2019**

**HIGHLIGHTS**

Average temperature over India during the year 2019 was above normal. During the year, annual mean surface air temperature, averaged over the country, was  $+0.36^{\circ}\text{C}$  above (1981-2010 period) average. The year 2019 was the seventh warmest year on record since nation-wide records commenced in 1901. However, the warming during 2019 was substantially lower than the highest warming observed over India during 2016 ( $+0.71^{\circ}\text{C}$ ).

The Global mean surface temperature anomaly during 2019 (January to October) was  $+1.1^{\circ}\text{C}$  as per WMO provisional statement on the state of global climate. (source: <https://public.wmo.int/en/resources/library/wmo-provisional-statement-state-of-global-climate-2019>).

The pre-monsoon and monsoon seasons with anomaly of  $+0.39^{\circ}\text{C}$  and  $+0.58^{\circ}\text{C}$  respectively mainly contributed to this warming.

The 2019 annual rainfall over the country as a whole was 109% of its Long Period Average (LPA) value for the period 1961-2010. The monsoon season (June-September) rainfall over the country as a whole was 110% of its 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.

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.

**Temperatures**

The 2019 annual mean land surface air temperature for the country was  $+0.36^{\circ}\text{C}$  above the 1981-2010 period average, thus making the year 2019 as the seventh warmest year on record since 1901 (Fig. 1)). The five warmest years on record in order were: 2016 ( $+0.71^{\circ}\text{C}$ ), 2009 ( $+0.541^{\circ}\text{C}$ ), 2017 ( $+0.539^{\circ}\text{C}$ ), 2010 ( $+0.54^{\circ}\text{C}$ ) and 2015 ( $+0.42^{\circ}\text{C}$ ). It may be mentioned that 11 out of 15 warmest years were during the recent past fifteen years (2005-2019). Past decade (2001-2010/ 2010-2019) was also the warmest decade on record with anomalies of  $0.23^{\circ}\text{C}$  /  $0.36^{\circ}\text{C}$ . The annual mean temperature during 1901-2019 showed an increasing trend of  $0.61^{\circ}\text{C}/100$  years (Fig.1) with significant increasing trend in maximum temperature ( $1.0^{\circ}\text{C}/100$  years) and relatively lower increasing trend ( $0.22^{\circ}\text{C}/100$  years) in

minimum temperature. The country averaged seasonal mean temperatures were also above the average during all the four seasons with the monsoon season (Jun-Sep, with anomaly  $+0.58^{\circ}\text{C}$ ) being the warmest since 1901. The country averaged mean monthly temperatures during 9 months of the year (except January, March and December) were warmer than the normal with mean temperatures exceeding the normal by about  $1^{\circ}\text{C}$  during June ( $1.02^{\circ}\text{C}$ , fourth warmest since 1901) and by about  $0.7^{\circ}\text{C}$  during the months of April ( $0.77^{\circ}\text{C}$ , seventh warmest), July ( $0.68^{\circ}\text{C}$ , warmest) and November ( $0.72^{\circ}\text{C}$ , third warmest).

## Rainfall

The annual rainfall over the country was 109 % of long period average (LPA). Time series of percentage departure of annual rainfall over the country as a whole since 1901 is shown in Fig. 2. Rainfall over the country as a whole during the SW monsoon season (June-September), which is the principal rainy season of the country, was normal (110 % of LPA). During this season, among the four large geographical regions of the country, Central India and South Peninsular India received 129% and 116% of its LPA rainfall respectively, while Northwest India received 98% and East & Northeast India received 88% of its LPA rainfall.

The 2019 northeast monsoon season (October-December) rainfall over the country as a whole was above normal (129% of LPA). The seasonal rainfall during the northeast monsoon season over the core region of the south peninsula (comprising of 5 subdivisions viz. Coastal Andhra Pradesh, Rayalaseema, Tamil Nadu & Puducherry, South Interior Karnataka and Kerala), was normal (109% of LPA). All the five subdivisions of the core region received excess/normal rainfall.

## High Impact Weather Events

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 3<sup>rd</sup> 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 "Pavan" 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 9<sup>th</sup> 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 four years (1893, 1926, 1930 and 1976). In case of Arabian Sea, the 5 cyclones 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 subdued as only 3 cyclones formed against the normal of 4 per year.

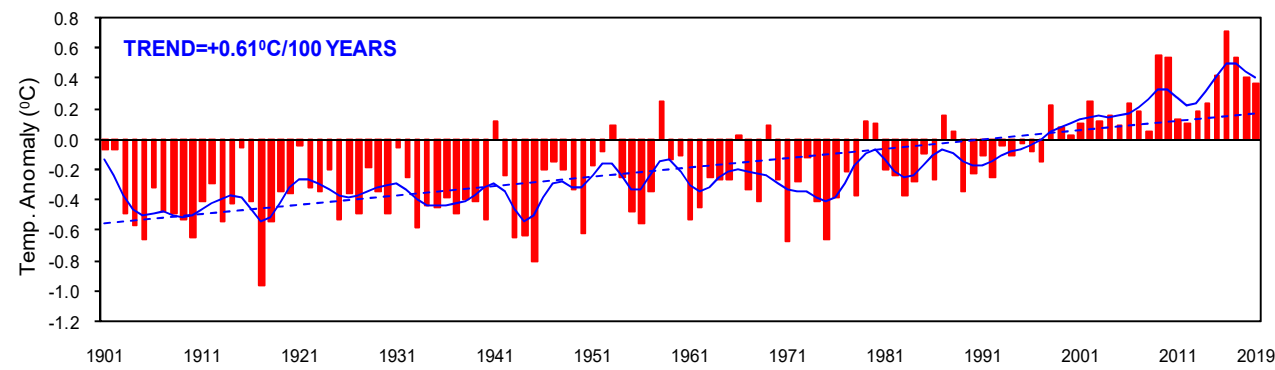
The country also experienced other high impact weather events like, extremely heavy rainfall, heat and cold waves, snow fall, thunderstorm, dust storm, lightning, floods etc. (Fig.3). A few events are listed below. The casualties mentioned here are based on the media and government reports. Bihar was the most adversely affected state during the year which reported about 650 lives due to Heavy rain & floods, heat wave, lightning, thunderstorm and hailstorm.

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.

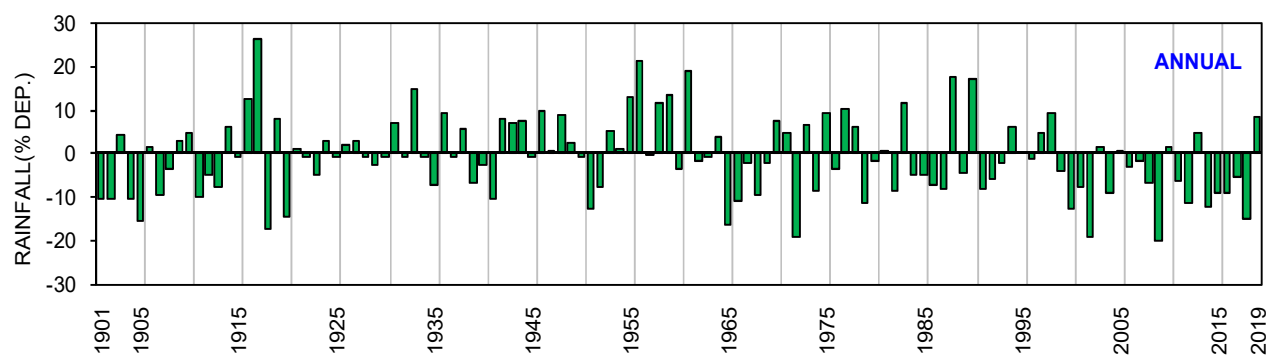
Heat wave conditions which prevailed over the northeastern & central parts of the country during the period March to June claimed about 350 lives. Of these, 293 lives were reported from the worst affected state of Bihar alone during June and 44 lives were reported from Maharashtra.

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.

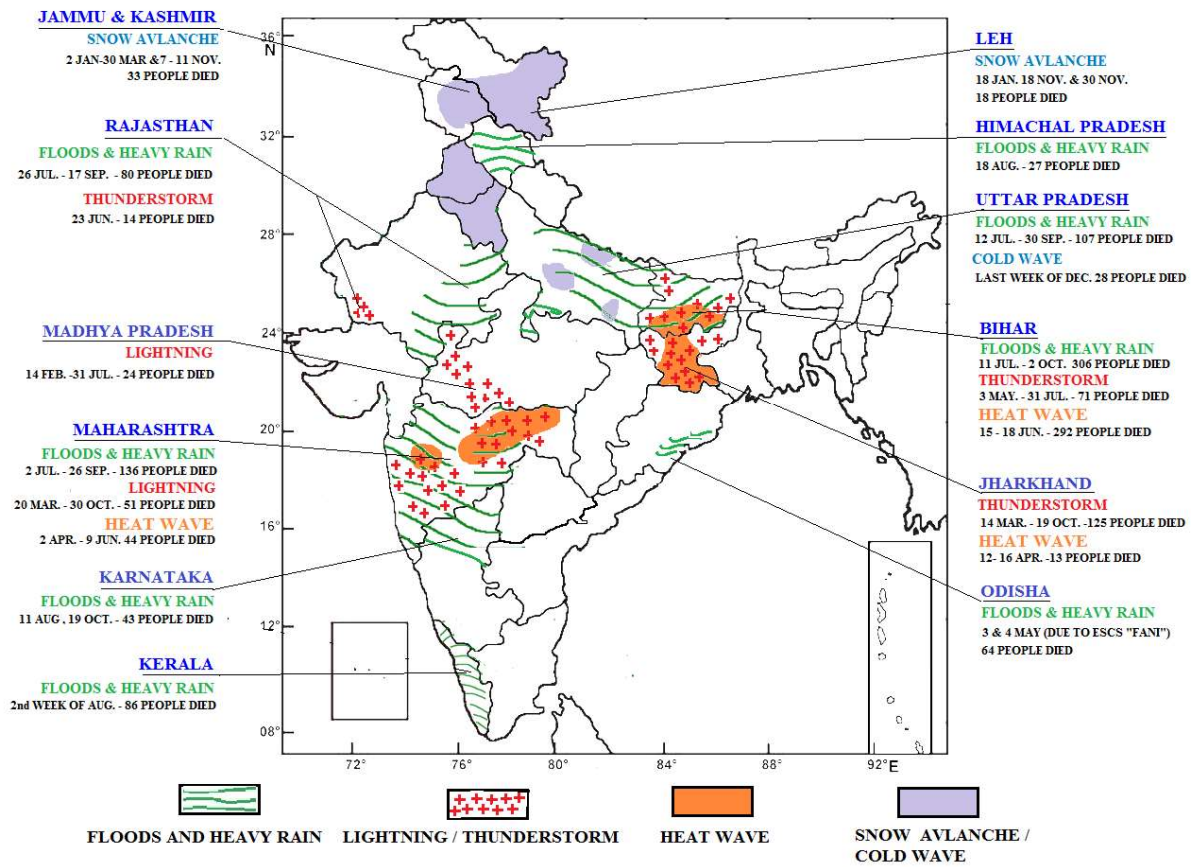
Snowfall and avalanche related incidents claimed 33 lives from Jammu & Kashmir & 18 from Leh. Cold wave claimed 28 lives from different parts of Uttar Pradesh during last week of December.



**Fig.1:** Annual mean land surface air temperature anomalies averaged over India for the period 1901-2019. The anomalies were computed with respect to base period of 1981-2010. The dotted line indicates the linear trend in the time series. The solid blue curve represents the sub-decadal time scale variation smoothed with a binomial filter.



**Fig. 2:** Time Series of All India Annual Rainfall percentage Departure (1901-2019)



**Fig. 3:** Major extreme weather events occurred during 2019 and the associated loss of life.

(\*:The casualties mentioned in the above figure are based on media reports and the same could not be authenticated from appropriate authorities.)