



**Earth System Science Organization (ESSO)
Ministry of Earth Sciences (MoES)
India Meteorological Department (IMD)
Climate Research and Services (CR & S)**

Statement on Climate of India during 2018

HIGHLIGHTS

Average temperature over India during 2018 was significantly above normal. During the year, annual mean surface air temperature, averaged over the country, was $+0.41^{\circ}\text{C}$ above (1981-2010 period) average. The year 2018 was the sixth warmest year on record since nation-wide records commenced in 1901. This was substantially lower than highest warming observed over India during 2016 ($+0.72^{\circ}\text{C}$). It may be mentioned that the Global mean surface temperature anomaly during 2018, is $+0.98^{\circ}\text{C}$ ($\pm 0.12^{\circ}\text{C}$, based on the data up to October 2018, source: <https://public.wmo.int/en/media/press-release/>).

The winter and pre-monsoon seasons with anomaly of $+0.59^{\circ}\text{C}$, and $+0.55^{\circ}\text{C}$, respectively mainly contributed to this warming. Mean temperature during the monsoon and post monsoon seasons (with anomaly of $+0.26^{\circ}\text{C}$, and $+0.31^{\circ}\text{C}$, respectively) were also above normal.

The 2018 annual rainfall over the country as a whole was 85% of Long Period Average (LPA) value for the period 1951-2000.

Temperatures

The 2018 annual mean land surface air temperature for the country was $+0.41^{\circ}\text{C}$ above the 1981-2010 average, thus making the year 2018 as the sixth warmest year on record since 1901 (Fig. 1)). The five warmest years on record in order were: 2016 ($+0.72^{\circ}\text{C}$), 2009 ($+0.56^{\circ}\text{C}$), 2017 ($+0.55^{\circ}\text{C}$), 2010 ($+0.54^{\circ}\text{C}$), 2015 ($+0.42^{\circ}\text{C}$). It may be mentioned that 11 out of 15 warmest years were during the recent past fifteen years (2004-2018). Past decade (2001-2010/ 2009-2018) was also the warmest decade on record with anomalies of 0.23°C / 0.37°C . The annual mean temperature during 1901-2018 showed an increasing trend of $0.6^{\circ}\text{C}/100$ years (Fig.1) with significant increasing trend in maximum temperature ($1.0^{\circ}\text{C}/100$ years), and relatively lower increasing trend ($0.2^{\circ}\text{C}/100$ years) in minimum temperature. The country averaged season mean temperatures were also above the average during all the four seasons with the winter season (January- February, $+0.59^{\circ}\text{C}$) being the 5th warmest since 1901 and the pre-monsoon season (March-May, with anomaly $+0.55^{\circ}\text{C}$ above average) being the 7th warmest ever since 1901. The country averaged mean monthly temperatures were warmer than the normal during all the months of the year (except December) with mean temperatures exceeding the normal by around 1°C during the two months (February (0.93°C) and March (0.96°C)).

Rainfall

The annual rainfall over the country was 85 % of Long Period (1951-2000) 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 was near normal (90.6 % of LPA). During this season, among the four large geographical regions of the country, South Peninsular India and Northwest India both received 98% of

their respective normal rainfall. Central India received of 93% of its LPA rainfall while East & Northeast India received 76% of its LPA rainfall.

The 2018 northeast monsoon season (October-December) rainfall over the country as a whole was substantially below normal (56% of LPA). This was 6th lowest since 1901. 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 also below average (66% of LPA). Out of these five subdivisions, one sub division Kerala received normal rainfall; the other four subdivisions received deficient rainfall.

High Impact Weather Events

During 2018, 6 cyclonic storms formed over the north Indian Ocean. Out of these 6 systems, 3 systems forming over the Arabian Sea (2 during the pre-monsoon season and one during the post-monsoon season), did not have landfall over the Indian region. The remaining three systems, which formed over the Bay of Bengal during the post monsoon season crossed Indian coast. The first system “Titli” formed over the east central Bay of Bengal on 8th October and crossed the Odisha coast on 11th. This storm claimed over 70 lives from coastal districts of Odisha. The second one “Gaja” which formed over the east central Bay on 10th November, crossed Tamil Nadu coast on 15th and after moving across the south peninsula, it re-emerged into Arabian Sea as a deep depression. This storm claimed over 40 lives from coastal districts of Tamil Nadu. The last cyclonic storm of the year “Phethai”, which formed over the southeast Bay of Bengal on 13th December, crossed the Andhra Pradesh coast on 17th. 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 are listed below. The casualties mentioned here are based on the media and government reports. Uttar Pradesh was the most adversely affected state during the year which reported near 600 deaths due to cold waves, thunderstorm, dust storm, lightning and floods.

Flood and heavy rain related incidents reportedly claimed over 800 lives from different parts of the country (viz. northern/northeastern, central & peninsular parts) during pre-monsoon, monsoon & post-monsoon seasons. Of these deaths, 223 deaths alone were reported from Kerala (8-23 August), 158 from Uttar Pradesh, 139 from Maharashtra and 116 from West Bengal during the monsoon season.

Thunderstorm was another major event of the year over the northeastern parts of the country which reportedly claimed 166 lives from Uttar Pradesh (April-May) and 75 from Jharkhand (June-July).

Dust storm claimed over 150 lives from Uttar Pradesh (92 lives, 2-6 May) and adjoining parts of Rajasthan (68 Lives, April-May).

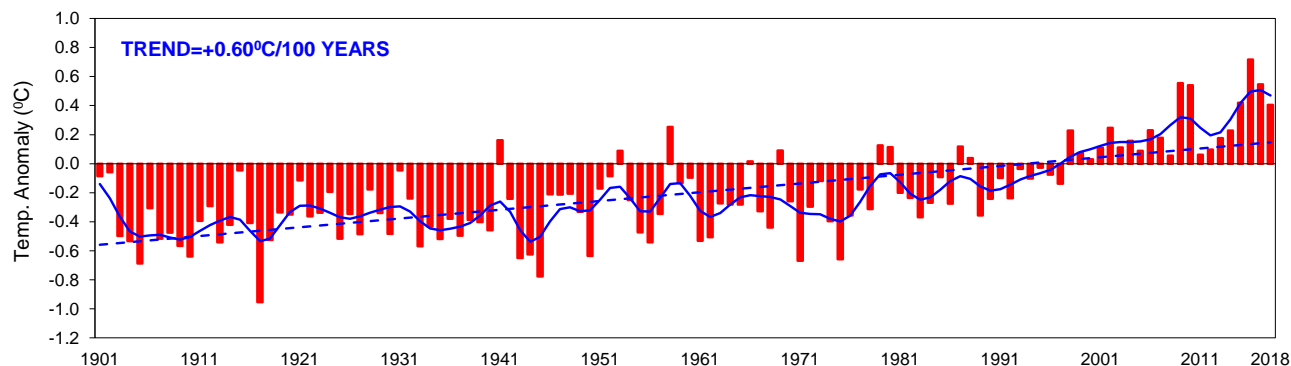


Fig.1: Annual mean land surface air temperatures anomalies averaged over India for the period 1901-2018. The anomalies were computed with respect to base period of 1981-2010. The dotted line indicates the linear trend in the time series. The solid blue curve represents the sub-decadal time scale variation smoothed with a binomial filter.

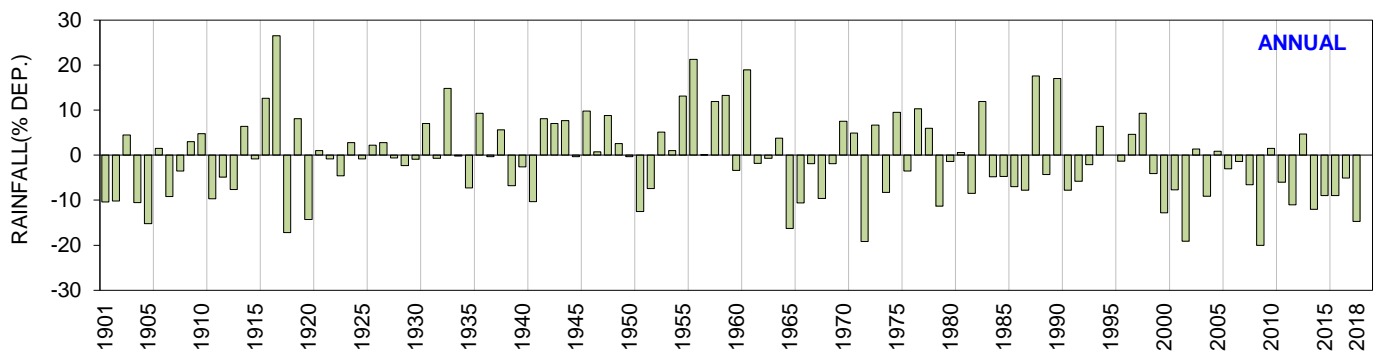


Fig. 2: Time Series of All India Annual Rainfall percentage Departure 901-2018)

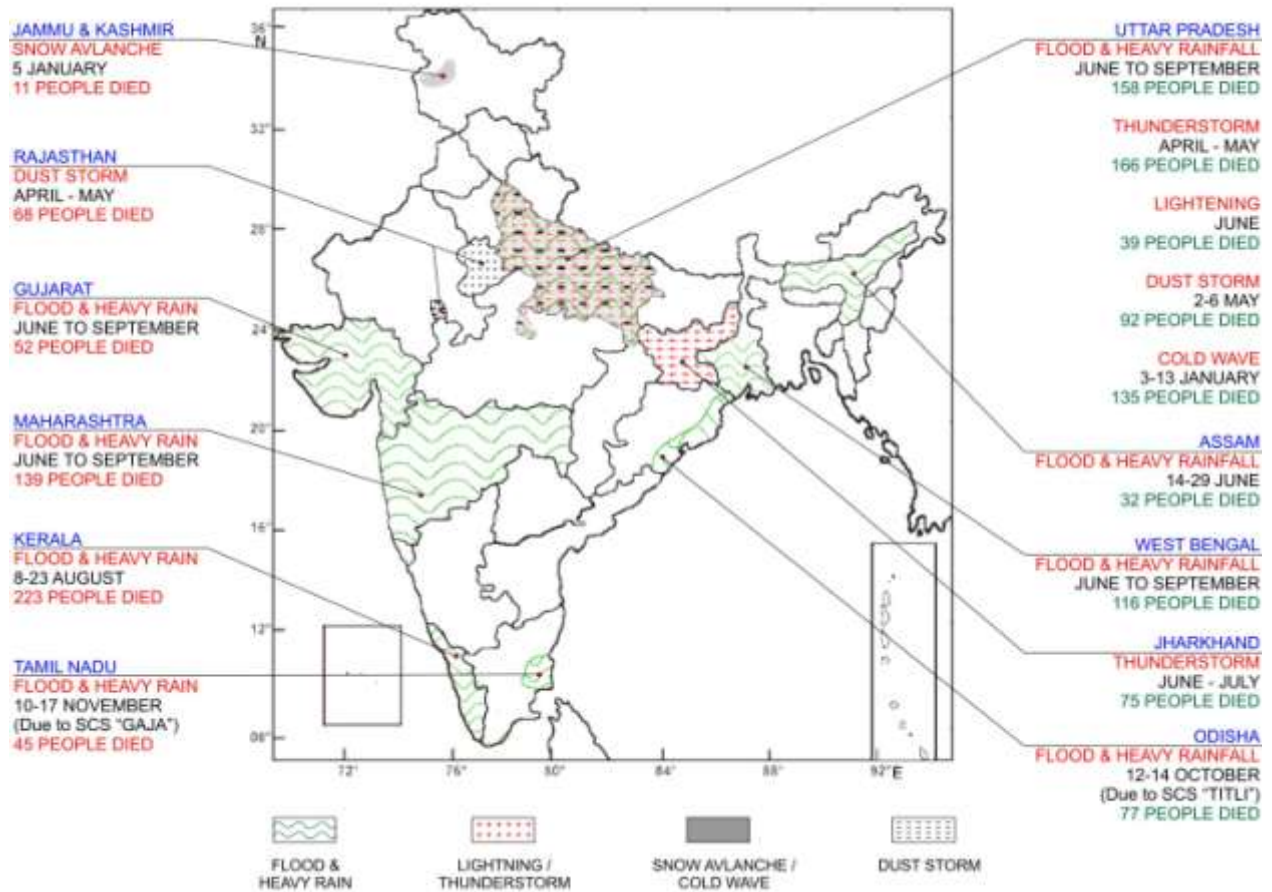


Fig. 3: Major extreme weather events occurred during 2018 and the associated loss of life.

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