PARLIAMENT QUESTION: EXTREME WEATHER EVENTS

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Government has been monitoring and recording the occurrence of various extreme weather events such as extreme rainfall, heat waves, cyclones, etc. across the country. There have been several studies that examined observed changes in extreme weather and climate events. Recently, the Ministry of Earth Sciences has also brought out a detailed assessment report covering various aspects of rainfall and temperature using longer period observed data as well as future simulations of these events and published in a book entitled "Assessment of Climate Change over the Indian Region" (https://link.springer.com/book/10.1007/978-981-15-4327-2). A brief summary of the observed trends in the various extreme weather events from the report are given below:

Temperature trends over India with regional changes: India's average temperature has risen by around 0.7°C during 1901–2018. This rise in temperature is largely on account of GHG-induced warming, partially offset by forcing due to anthropogenic aerosols and changes in LULC. In the recent 30-year period (1986–2015), temperatures of the warmest day and the coldest night of the year have risen by about 0.63°C and 0.4°C, respectively.

Sea Level Rise: Sea levels have risen globally because of the continental ice melt and thermal expansion of ocean water in response to global warming. Sea-level rise in the North Indian Ocean (NIO) occurred at a rate of 1.06–1.75 mm per year during 1874–2004 and has accelerated to 3.3 mm per year in the last two and a half decades (1993–2017).

Tropical Cyclones: There has been a significant reduction in the annual frequency of tropical cyclones over the NIO basin since the middle of the twentieth century (1951–2018). In contrast, the frequency of very severe cyclonic storms (VSCSs) during the post-monsoon season has increased significantly (+1 event per decade) during the last two decades (2000–2018).

Changes in the Himalayas: The Hindu Kush Himalayas (HKH) experienced a temperature rise of about 1.3°C during 1951–2014. Several areas of HKH have experienced a declining trend in snowfall and also the retreat of glaciers in recent decades. In contrast, the high-elevation Karakoram Himalayas have experienced higher winter snowfall that has shielded the region from glacier shrinkage.

Heavy rainfall and Drought: Frequency of daily precipitation extremes (rainfall intensities >150 mm per day) increased by about 75% during 1950-2015. The frequency and spatial extent of droughts over India has increased significantly during 1951-2015.

To enhance early warning capability, the Government has taken various steps under Monsoon Mission and Mission Mausam projects. Under these projects, observational and modeling systems have been strengthened across the country with additional AWS, ARG, and Doppler Weather Radars (DWRs), etc. There is improvement in data integration, NWP models, climate models, and in the development of GIS-based DSS. There has also been significant improvement in the real-time seamless monitoring, forecasting, and early warning of various extreme weather events such as cyclones, heatwaves, and heavy rainfall.

Under the above projects, two global forecast models, GFS 12 km and NCUM 12 km, have been operational in real time since 2018. Recently (in May 2025), the Bharat Forecasting System (BharatFS) was made operational to generate weather forecasts at a very high resolution of 6 km to cater weather services at block and panchayat levels. The computing facilities have also been substantially increased to integrate voluminous data and run mesoscale, regional, and global models at higher resolution. With the implementation of the HPC Systems "Arunika" and "Arka" in 2025, the Ministry of Earth Sciences has enhanced its total computing power to 28 Peta FLOPS, a substantial increase from the previous capacity of 6.8 Peta FLOPS in 2014.

For effective utilization of Observational and NWP products and providing timely early warning against all types of severe weather, IMD has developed an end-to-end GIS-based Decision Support System (DSS), which has been working as the front end of the early warning systems for the timely detection and monitoring of all-weather hazards. It is supported with specific severe weather modules in order to provide timely impact-based early warnings for extreme weather events like cyclones, Heavy rainfall, Thunderstorms, lightning, Fog, heatwaves, etc, which have devastating impacts on human lives, livelihoods, and infrastructure. This system uses all past historical data, their extremes, as well as real-time surface and upper air meteorological observations available to the system for the Indian region and neighbourhood. It also includes RADAR observations available every 10 minutes and Satellite products every 15 minutes. It also uses Numerical Weather Prediction (NWP) products from a suite of models run in MoES. The models include meso-scale (including hyperlocal), regional, and global models. Various models (hyperlocal and mesoscale) are currently operational in real time at the India Meteorological Department (IMD) and other MoES centres. To provide impact-based forecasts and warnings, DSS integrates exposure and hazard data.

Various steps have been taken to improve last-mile dissemination of weather alerts, including Impact-Based Forecasting services and early warning dissemination, which have been strengthened through official IMD websites, Common Alerting Protocol (CAP), WhatsApp groups, mobile applications, web portals, SMS alerts, and closer coordination with disaster management authorities. To further advance weather and climate services in India, IMD conducts multiple state-level stakeholder consultation workshops with various state government departments. These engagements include users from agriculture, water resources, energy, disaster management, transport, aviation, media, health, urban planning, and local communities. The discussions help identify practical gaps, emerging needs, and opportunities to improve the usability, accessibility, and reach of weather and climate services across the country.

This information was submitted by Union Minister of State (Independent Charge) for Earth Sciences, Dr. Jitendra Singh in Rajya Sabha on 12 March 2026.

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