

PARLIAMENT QUESTION: IMPACT OF CLIMATE CHANGE ON WEATHER PATTERNS

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Various initiatives have been undertaken to effectively address the potential impacts of climate change on India's weather patterns, especially the increasing frequencies of various severe weather events, e.g., heavy rainfall events, heat waves, etc. The India Meteorological Department (IMD), under the Ministry of Earth Sciences (MoES), in coordination with other centers and State Government, Ministry of Home Affairs (MHA), NDMA, is working round the clock to monitor, detect, and provide forecasts and issue timely warnings at a more granular scale for these severe weather events and their hazards. For improving the detection of these events at a more granular, temporal scale, there has been a quantum jump in observational systems, with the expansion of AWS/ARG networks, Doppler Weather Radars (DWRs), etc. Currently, 47 DWRs are in operation across India, with 87% of the total area of the country coming under radar coverage. Additionally, the Ministry of Earth Sciences (MoES) launched Mission Mausam with the goal of making India a "Weather-ready and Climate-smart" nation, aiming to mitigate the impacts of climate change and extreme weather events.

Under the Mission Mausam, the Bharat Forecast System (BharatFS), an advanced computer simulation model, has already been developed, and it has been operational at a very high spatial resolution of 6 km. It also has the capability to provide predictions of rainfall events up to 10 days, covering the short and medium-range forecasts. Due to its higher resolution and improved dynamics, it generates weather forecasts at the panchayat or cluster of panchayats level. To further support the operations of high-resolution model simulations in real-time, the high-performance computing facilities (Arunika and Arka) have been substantially increased to integrate voluminous data and run meso-scale, regional, and global models.

Further, a major achievement is the introduction of the Mithuna Forecast System (Mithuna-FS). This new-generation global coupled model integrates the atmosphere, ocean, land surface, and sea ice components with state-of-the-art physics and an upgraded data assimilation framework. Currently, this forecasting system operates at 12-km resolution, marking a significant advancement in India's medium-range localized weather forecasting capability. The Mithuna-FS suite also includes –

- A 4-km high-resolution regional model for accurate simulation of monsoon dynamics, cyclones, and mesoscale extreme events over the Indian subcontinent;
- A 330-m hyper-resolution urban model for fog, visibility, and air-quality forecasting over the Delhi region.

These models operate on the supercomputer and assimilate dense observational inputs from radars, satellites, automatic weather stations (AWS), profilers, and ocean systems. Together, they enable high-quality, panchayat-level predictions of rainfall, thunderstorms, fog, heat stress, and pollutants. These models under the Mission Mausam are specifically configured for India's diverse climate regimes. For effective utilization of observational and NWP products and for providing timely early

warning against all types of severe weather, IMD has developed an end-to-end GIS-based Decision Support System (DSS), which serves as the front end of the early warning systems for the timely detection and monitoring of all-weather hazards.

(b) The IITM Earth System Model (IITM-ESM) is developed in-house at the Indian Institute of Tropical Meteorology (IITM), Pune, for studying the long-term climate variability and change with a special focus on the South Asian region and monsoon. IITM-ESM has contributed to the Coupled Model Intercomparison Project for understanding the increasing climate extremes over the globe and over the Indian region. IITM-ESM has also contributed to climate change assessments, including the Intergovernmental Panel on Climate Change Sixth Assessment Report, the first from India, and National Assessment Report “Assessment of Climate Change over the Indian Region” by the Ministry of Earth Sciences. Assessment of Climate Change over the Indian Region (<https://link.springer.com/book/10.1007/978-981-15-4327-2>), provides important information on the regional climate change over India.

(c) India is actively collaborating with international programs like the Coupled Model Intercomparison Project (CMIP), the World Climate Research Programme (WCRP), the World Weather Research Program, etc., on weather and climate research and to develop and improve weather and climate models. These models aim to simulate and predict the interactions between the atmosphere, ocean, and polar regions, crucial for understanding regional extremes and climate impacts. These collective actions contribute to a more robust understanding of Earth System interactions, which is essential for enhancing India’s resilience to extreme weather and climate change impacts. The Centre for Climate Change Research (CCCR) established by MoES at the IITM, Pune has set up infrastructure (ESGF data node) that facilitate the dissemination of the global and regional climate model’s based data in order to support various stakeholders (vulnerability, impacts and adaptation (VIA) communities) for informed use of regional climate information. The global climate change projections are generated using the IITM-ESM as part of the Coupled Model Intercomparison Project and Intergovernmental Panel on Climate Change (IPCC). Regional climate change projections over South Asia are generated as part of the Co-ordinated Regional Downscaling Activity (CORDEX). These data sets are shared globally through the ESGF node at IITM and can be accessed via the following link;

https://esg-cccr.tropmet.res.in/thredds/catalog/esg_dataroot6/catalog.html

https://esg-cccr.tropmet.res.in/thredds/catalog/esg_dataroot4/cordex/catalog.html

This information was submitted by Minister of State (Independent Charge) Earth Sciences Dr. Jitendra Singh in Rajya Sabha on 5th February 2026.

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