

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 356
ANSWERED ON 06/02/2025

MONSOON PREDICTION

356. DR. ASHOK KUMAR MITTAL:

Will the Minister of **EARTH SCIENCES** be pleased to state:

- (a) the methods and technologies employed by IMD to ensure the accuracy of its monsoon predictions, and how often these models are updated to reflect new climate data;
- (b) the steps taken by Government to address discrepancies between the IMD's rainfall predictions and actual rainfall patterns observed in specific regions;
- (c) the measures undertaken to improve the accuracy of long-range monsoon forecasts, particularly in light of the challenges posed by climate change; and
- (d) whether Government conducted any third-party audits or reviews of the IMD's predictive models to ensure their reliability, and if not, the reasons therefor?

ANSWER
THE MINISTER OF STATE (INDEPENDENT CHARGE) FOR
MINISTRY OF SCIENCE AND TECHNOLOGY
AND EARTH SCIENCES
(DR. JITENDRA SINGH)

- (a)-(b) The India Meteorological Department (IMD) has adopted a new strategy for issuing monthly and seasonal operational forecasts for the southwest monsoon rainfall over the country based on both the statistical forecasting system and the newly developed Multi-Model Ensemble (MME) based forecasting system. The MME approach uses the coupled global climate models (CGCMs) from different global climate prediction and research centers, including IMD's Monsoon Mission Climate Forecasting System (MMCFS) model. The MMCFS and MME data are updated every month. This was to satisfy the demands from different users and Government authorities for forecasting the spatial distribution of seasonal rainfall along with the regionally averaged rainfall forecasts for better regional planning of activities.

Since introducing the Statistical Ensemble Forecasting System (SEFS) in 2007 and using the MME approach in 2021 for seasonal forecasting, IMD operational forecast for the monsoon rainfall has shown noticeable improvement. For example, the absolute forecast error in the forecasting of all India's seasonal rainfall reduced by about 21% during the recent 18 years (2007-2024) compared to the same number of years (1989-2006), which indicates a highly successful forecast in recent years compared to previous years.

The average absolute error of forecast of Indian summer monsoon rainfall during the last 10 years (2015-2024) was 5.01% of the long period average (LPA), whereas 5.97% was during 2005-2014. The correlation coefficients between the actual and forecast rainfall for (2015-2024) & (2005-2014) are 0.61 & 0.37, respectively. IMD was able to correctly forecast the twin deficient monsoon years of 2014-2015, as well as below-normal rainfall in 2023 and above-normal rainfall in 2024. These indicate improvements in the operational forecast system in the recent 18 years compared to the earlier 18 years.

- (c) The Ministry has launched the National Monsoon Mission (NMM) to develop a state-of-the-art dynamical prediction system for monsoon rainfall in different time scales. This has focused on seasonal (June-September) and extended-range prediction of Indian summer monsoon rainfall (ISMR), with delineation of active/break spells, using high-resolution ocean-atmosphere coupled dynamical models with reasonable skill, as well as short-range forecasts. Through NMM, two state-of-the-art dynamical prediction systems were implemented for short-range to medium-range, extended-range, and seasonal forecasts.

Recently, the Mission Mausam was launched in September 2024, and it is envisaged to be a multi-faceted and transformative initiative to boost India's weather and climate-related science, research, and services. It will help better equip stakeholders, including citizens and last-mile users, to tackle extreme weather events and the impacts of climate change. Besides physics-based numerical models, IMD is developing new methods based on artificial intelligence (AI) and machine learning (ML) technologies for weather and climate.

- (d) There is an existing research advisory committee (RAC), which is an independent review committee constituted by the MoES with expert members from the Indian Institute of Tropical Meteorology (IITM), National Center for Medium Range Weather Forecasting (NCMRWF), and Indian National Center for Ocean Information Services (INCOIS), Indian Space Research Organisation (ISRO), and academia. Based on the guidance of this committee, the models used for monsoon forecasting are reviewed and improved from time to time. This committee meets annually once to review these activities.
