GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 1480
ANSWERED ON 12/02/2026

ACCURACY OF WEATHER FORECASTING SYSTEMS

1480. SHRI S. SELVAGANABATHY:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) the latest assessment of accuracy of India Meteorological Department's (IMD) operational forecasts for southwest monsoon during the current year, along with year-on-year improvements achieved since introduction of multi-model ensemble forecasting;
(b) the details of tools, models and observation systems presently in use for seasonal and short range weather prediction including high-performance computing facilities and AI/ML enabled forecasting systems; and
(c) the status of expansion of Doppler Weather Radar (DWR) network across the country and the extent to which this has strengthened forecasting for severe events such as cloudbursts, thunderstorms, lightning and cyclones?

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

(a) The India Meteorological Department (IMD) has been following a seamless forecasting strategy for monsoonal rainfall. As per this strategy, it issues forecasts and warnings on different time scales and for different spatial scales. Nowcasting- up to six hours for all types of severe weather at all districts and around 1200 stations. Short to medium range (up to 7 days) forecasts for rainfall over cities, blocks, districts, and meteorological subdivisions. Extended range (up to 4 weeks) forecasts for 36 meteorological sub-divisions. Monthly and seasonal long-range forecasts for rainfall for the whole country and for homogenous region.

The latest assessment of the accuracy of its seasonal long range for Southwest Monsoon in the current year 2025 shows it was highly accurate and the forecast, issued in April 2025, for the southwest monsoon (June-September) rainfall over the country as a whole was 105% of long period average (LPA) while the actual season rainfall for the country as a whole was 108 % of LPA and it was within errors range of the forecast issued. The spatial probability forecasts were also largely accurate across most regions of the country. Similarly, the monthly rainfall forecasts closely matched the observed values and remained within the forecast limits.

The latest assessment of Heavy rainfall Forecast Performance shows in 2025, the heavy rainfall forecast demonstrated high skill, with Probability of Detection of 0.85, indicating it was in overall accuracy.

IMD has adopted a new strategy for monthly and seasonal forecasting since 2021 based on the Multi-Model Ensemble (MME) approach. The strategy utilizes coupled global climate models (CGCMs from various global climate prediction and research centers, including IMD's Monsoon Mission Climate Forecasting System (MMCFS). The performance of IMD's seasonal forecasting system has shown improvement following the adoption of the MME-based approach. The verification details of IMD's seasonal forecasts for All India Summer Monsoon Rainfall for the period 2021 to 2025 are given below:

Year	ALL India Monsoon Rainfall (LPA)		
	Actual (%)	Forecast (%)	Remark
2021	99	101	Accurate
2022	106.5	103	Accurate
2023	95	96	Accurate
2024	108	106	Accurate
2025	108	106	Accurate
***Model error ± 4% of LPA			

(b) For seasonal and short-range weather prediction, IMD uses a range of advanced tools, models, and observation systems as part of its operational forecasting framework. Under the Mission Mausam project, already Bharat Forecast System (BharatFS), an advanced computer simulation model has been developed, and it has been operational at a very high spatial resolution of 6 km. It has also a capability to provide predictions of rainfall events up to 10 days, covering the short and medium range. Further, to support such high-resolution models running regularly, the Computing facilities have also been substantially increased to integrate voluminous data and to run meso-scale, regional, and global models at higher resolution. Recently, with the implementation of the High Power Computing Systems "Arunika" and "Arka", the Ministry of Earth Sciences has enhanced its total computing power to 28 Peta FLOPS in 2025, a substantial increase from the previous capacity of 6.8 Peta FLOPS in 2014.

IMD is gradually integrating artificial intelligence (AI) and machine learning (ML)–based methods to enhance model performance, post-process model outputs, pattern recognition, bias correction, and probabilistic forecast interpretation. The weather observation system presently consists of 48 Doppler Weather Radars (DWRs) covering nearly 92% of the country, along with high-resolution satellite-based monitoring and around 6,300 rain gauge stations.

(c) There are a total of 48 DWRs installed and operational in India. The locations where the DWR network has been established across the country are given in Annexure-1. This has helped IMD improve monitoring and forecasting of severe events such as cloudbursts, thunderstorms, lightning, and cyclones.

Annexure-1

Locations of the current Doppler Weather Radar (DWR) network in the country:

S. No.	State	Location
1.	Andhra Pradesh	Machilipatnam
2.	Andhra Pradesh	Visakhapatnam
3.	Andhra Pradesh	Sriharikota, ISRO
4.	Assam	Mohanbari
5.	Assam	Jorhat
6.	Bihar	Patna
7.	Chhattisgarh	Raipur
8.	Goa	Goa
9.	Gujarat	Bhuj
10.	Himachal Pradesh	Jot
11.	Himachal Pradesh	Murari Devi
12.	Himachal Pradesh	Kufri
13.	Karnataka	Mangalore
14.	Kerala	Kochi
15.	Kerala	VSSC, Thiruvananthpuram (ISRO)
16.	Madhya Pradesh	Bhopal
17.	Madhya Pradesh	Silkheda (IITM)
18.	Maharashtra	Mumbai
19.	Maharashtra	Nagpur
20.	Maharashtra	IITM Solapur
21.	Maharashtra	Veravali
22.	Maharashtra	Mumbai, Juhu (IITM)
23.	Maharashtra	Mumbai, Panvel (IITM)
24.	Maharashtra	Mumbai, Kalyan, Dombivali (IITM)
25.	Maharashtra	Mumbai, Vasai, Virar (IITM)
26.	Maharashtra	Mahabaleshwar (IITM)
27.	Meghalaya	Cherrapunji (ISRO)
28.	Odisha	Gopalpur

29.	Odisha	Paradip
30.	Punjab	Patiala
31.	Rajasthan	Jaipur
32.	Tamil Nadu	Chennai
33.	Tamil Nadu	Karaikal
34.	Tamil Nadu	NIOT Chennai
35.	Telangana	Hyderabad
36.	Tripura	Agartala
37.	Uttarakhand	Lansdowne
38.	Uttarakhand	Mukteshwar
39.	Uttarakhand	Surkanda Devi
40.	Uttar Pradesh	Lucknow
41.	West Bengal	Kolkata
42.	Jammu & Kashmir	Banihal Top
43.	Jammu & Kashmir	Jammu
44.	Jammu & Kashmir	Srinagar
45.	Delhi	Ayanagar
46.	Delhi	Palam
47.	Delhi	HQ Mausam Bhawan
48.	Ladakh	Leh

****