GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 354
ANSWERED ON 06/02/2025

WEATHER FORECAST

354.   SHRI SANJAY SETH:

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

(a)   the manner in which "Mission Mausam" aims to enhance country's weather forecast capabilities and its impact on disaster management;
(b)   the significance of AOMSUC-14 in fostering regional unity and its contributions to satellite meteorology;
(c)   the measures undertaken by the country to achieve a 50 per cent improvement in weather forecast accuracy; and
(d)   the role of improved forecasting in strengthening country's preparedness for natural disasters?

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

(a)   Mission Mausam 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. The Mission Mausam is launched to make Bharat a "weather-ready and climate-smart" nation, with the following objectives:

- Strengthening observations (in-situ & remote sensing).
- Gaining a better understanding and use of Science, Innovation and Technology, and Data Science for societal benefit.
- Improve our Model/Data Assimilation/HPC for giving accurate information to the Public and stakeholders (Numerical+Artificial Intelligence and Machine Learning).
- Developing advanced Earth System Models and data driven methods, including the use of AI/ML.
- Trained Manpower in Earth System Science.
- Forecast dissemination: Effective communication with Society: Early Warning for ALL.

Mission Mausam is expected to enchance weather monitoring and provide accurate forecasts across various timescales. This will be achieved through the deployment of next-generation observation systems, high-performance computing infrastructure, and advanced Earth system models. The integration of artificial intelligence (AI) and machine learning (ML) technologies will further improve the precision of predictions by enhancing model accuracy and prediction resolution.

The Mission Mausam will utilize an seamless forecasting approach that includes:

- Short-term forecasts (up to 72 hours): These will be based on high-resolution models by assimilating atmospheric data from next-generation radars, satellites, wind profilers, etc.
- Medium-term forecasts (3 to 15 days): The system will use advanced modeling techniques and high-performance computing resources to predict weather patterns with higher accuracy.
- Long-term forecasts (seasonal to annual): The system will be used to predict large-scale weather and climate patterns, providing forecasts for months or seasons in advance.

These improvements are expected to offer better precision in monitoring and forecasting all types of extreme weather and climate events, generating sector specific impact forecast and advisories for various sectors such as agriculture, disaster risk reduction, water, energy, health, and transportation, and dissemination of warnings and advisories.

(b)   The 14th Asia-Oceania Meteorological Satellite Users' Conference (AOMSUC-14) was hosted by the India Meteorological Department (IMD), Ministry of Earth Sciences (MoES), in New Delhi from December 2–7, 2024. It brought together global experts, including the World Meteorological Organization (WMO) representatives national meteorological services like Australian Bureau of Meteorology (AuBoM), Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG), Japan Meteorological Agency (JMA), Korea Meteorological Administration (KMA), Group on Earth Observations (GEO), National Oceanic and Atmospheric Administration (NOAA), and leading satellite agencies. The objective of the event was to showcase the recent advancements in the satellite technology for addressing regional challenges like climate change, extreme weather, and disaster management. It has helped in further strengthening India's capabilities in the use of satellite meteorological data for monitoring and forecasting of extreme weather events and thereby enhancing climate resilience.

(c)-(d) In addition to the implementation of the mission Mausam as described in answer to question (a), the other measures undertaken by the MoES to achieve a 50% improvement in weather forecast accuracy are given in Annexure-1. It was mainly due to the strengthening of various observational networks, the utility of new observing and monitoring systems/techniques, improvement in the data assimilation and adaptation of high-resolution numerical weather prediction (NWP) models, development and utility of various web-based DSS models of severe weather events, especially Dynamic Composite Risk Atlas (Web-DCRA) and Decision Support System (DSS) tool for real-time cyclone and associated impact and timely dissemination to all users using all latest digital-based communication systems. Infrastructure development and extension of services to various sectors also helped with such improvements.

**Measures taken for Improving
IMD's Weather Forecasting Capabilities from 2014 to 2024**

Improvement in the various observational networks:

Observational Network	2014	2024
DWRs (Doppler Weather Radars)	15	39
AWS (Automatic Weather Stations)	675	1208
Upper air observation systems (RS/RW)	43	56
High Wind Speed Recorders	19	37
GPS-based PB stations	00	25
RVR systems at Air	20	169
AWOS (Automated Weather Observing Systems)	00	07
HAWOS (Heliport Weather Observing Systems)	00	10
District-wise Rainfall Monitoring stations (DRMS)	3955	6095

Upgradation of Forecasting System Across the Time Scales by Implemention of New High-resolution NWP models:

Model	2014	2024
Regional Models - Nowcast (Forecast up to next 12 hours) to Short Range (Forecast up to next 3 days)	• Weather Research and Forecasting (WRF) model 27kmx3km; used to be run two times a day and forecast was for 3 days. • Hurricane-WRF (HWRF) used to run only during cyclone. 27kmx9km; Forecast was for 3 days. • High resolution Rapid Refresh and Electric–WRF were not available till 2014.	• WRF model runs with 3 km resolution for whole area; updated 4 times a day and forecast is issued up to 3 days. • HWRF runs at 18x6x2 km with coupled ocean model, forecast issued up to 5 days. • Besides, High resolution Rapid Refresh (HRRR-2km, hourly) has been introduced with forecast up to 12 Hrs updated every 2 hours. • Electric–WRF (E-WRF-3km, hourly) is also used for issuing forecast two times a day with validity upto 24 hours.
Global Atmospheric Models - Medium Range Models (Forecast up to 10 days).	• Global Forecast System (GFS) (T574 resolution) used to run with about 25km resolution, updated 2 times a day and forecast was issued for 7 days. • There was no operational ensemble prediction system in IMD till 2014.	• Global Forecast System (GFS) (T1534) is utilized with 12km resolution updated 4 times a day and forecast is issued for 10 days. • Global Ensemble Forecast System (GEFS) runs at 12km resolution; Updated twice a day and forecast is issued up to 10 days.

Atmosphere-Ocean Coupled Models - Extended Range Models (Forecast up to next 28 days)	• No NWP model was operational at IMD till 2014. • Forecast was prepared based on other NWP models from abroad. Forecast was issued once in a week	• Coupled model (CFSv2) was operationalized in IMD since 2017. • Couple model, CFSv-2 is operational in IMD with resolution about 38km and forecast and hindcast updated once in a week and forecast is issued for 4 weeks.
Seasonal Forecast Models	• Based on statistical model monsoon rainfall forecast was issued for country as a whole.	• Multi-model ensemble (MME) based monsoon rainfall and temperature forecast is issued for country as whole along with spatial distribution over the Indian region. Besides, Forecast is updated once in a month for one month forecast along with the seasonal update.

Widening the Digital-based Communication Systems:

India Meteorological Department (IMD) has developed an easy-to-use website to communicate meteorological forecasts, events, and warnings to the public. The website provides 7-day warnings, 7-day rainfall forecasts, and Nowcast warnings, which can be viewed sub division-wise, district-wise, and station-wise. Current weather conditions for major cities are also highlighted to guide the public. It includes dissemination of forecasts and warnings through websites, email, SMS, and Social Media such as Facebook, Twitter, Instagram, etc. IMD's unified multilingual mobile app integrates various features such as agromet, aviation, crowd-source, cyclone, lightning, and rain alerts under a single umbrella, making all this information easily accessible. The IMD continuously improves its website and mobile application to provide citizens with an enhanced and smooth experience. India Meteorological Department is making efforts to provide weather information to the public through various platforms:

- Mass Media: Radio/TV, News Paper network (AM, FM, Community Radio, Private TV), Prasar Bharati and private broadcasters
- Weekly & Daily Weather Video
- Internet (email), FTP
- Public Website (mausam.imd.gov.in)
- IMD Apps: Mausam/Meghdoot/DAMINI/RAIN ALARM
- Social Media: Facebook, Twitter, Instagram, BLOG

  i. X: https://twitter.com/Indiametdept
  ii. Facebook: https://www.facebook.com/India.Meteorological.Department/
  iii. Blog: https://imdweather1875.wordpress.com/
  iv. Instagram: https://www.instagram.com/mausam_nwfc
  v. Youtube: https://www.youtube.com/channel/UC_qxTReoq07UVARm87CuyQw

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