

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 356
ANSWERED ON 25/07/2024

IMPROVING WEATHER FORECASTING IN THE COUNTRY

356. SHRI S NIRANJAN REDDY:

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

- (a) whether Government has taken steps to improve weather forecasting in the light of increase in sudden and disruptive weather conditions induced by climate change;
- (b) the specific measures implemented by Government to improve weather forecasting techniques in the country;
- (c) whether Government has considered using weather nowcasting techniques to improve live and hyperlocal weather monitoring, and the extent to which these techniques are being integrated into current weather forecasting systems in the country; and
- (d) whether emerging technologies like AI are currently being used to improve weather forecasting in the country, if so, the details thereof?

ANSWER

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

- (a) Yes.
- (b) The India Meteorological Department (IMD) has adopted new techniques and technology from time to time to detect, monitor, and provide timely early warnings for disruptive weather events. Initiatives and developments have been taken to improve the monitoring and forecasting of weather events by augmenting the observational network, numerical weather prediction models, and supercomputers. The details are given below:
 - 39 Doppler Weather Radars network
 - 1208 Automatic Weather Stations
 - 1382 Automatic Rain Gauges
 - 35 High Wind Speed Recorders
 - 56 Upper Air Observation Systems
 - 23 Global Positioning SystemBased Pilot Balloon Stations
 - 138 Runway Visual Range
 - 107 Digital Current Weather Systems
 - 8 Heliport Weather Observing Systems
 - 5896 District-wise Rainfall Monitoring Scheme

- Developed Climate vulnerability Atlases over India.
- Hot Weather Hazard Analysis for India, including daily temperature, moisture, wind, and humidity.
- Implementation of heat index forecast
- Heat Action Plans in 23 States that are prone to heatwave conditions jointly implemented by the national disaster management authority in collaboration with the State Governments
- Supercomputers: (i) Pratyush (6.8 PetaFlops), (ii) Mihir (2.8 PetaFlops).
- High-resolution weather forecasting models.
- Multi-Model Ensemble technique has been developed for forecasting at different spatial scales.

IMD utilizes a seamless forecasting system at seasonal to nowcast scale and implemented well-defined Standard Operating Procedures (SOPs) for monitoring & forecasting weather hazards.

IMD uses a state-of-the-art dissemination system to share all severe weather information and early warnings with disaster management authorities and the general public through various platforms/channels for necessary preparedness and to support mitigation measures. It includes social media, Common Alert Protocol, Mobile Apps, WhatsApp, and APIs. As a result, the vulnerable population gets evacuated from the damage-prone areas on time to safe shelters, thereby reducing the human death toll to a bare minimum.

(c) Yes. IMD is implementing live current weather data and hyperlocal weather monitoring services in the category of nowcast services, in real time. The current status of these services are the following

- IMD uses all its surface and upper air observations available live across the Indian region at the highest spatial (sub-city and district levels) and temporal scale (10-15 minute intervals) through GTS, IMD DSS, and Website.
- IMD also continuously uses RADAR observations and satellite products at hyperlocal scales up to district levels.
- For major cities like Mumbai, Chennai, Delhi, etc., it has enabled such monitoring systems up to sub-city levels by installing dense AWS/ARG networks with additional Doppler Weather Radars (DWRs).
- These efforts help in reporting all surface observations like temperature, wind, rainfall, etc., and monitoring cloud characteristics for nowcasting.
- IMD also attempted to integrate all hyperlocal observations into an advanced numerical weather prediction modeling system with sophisticated continuous data assimilation techniques to capture localized extreme weather events.

- Currently, the mesoscale models run at a hyperlocal scale are given below:
 - (i) High-Resolution Rapid Refresh (HRRR-2km)
 - (ii) ElectricWeather Research and Forecasting (EWRF-3km)
 - (iii) Weather Research and Forecasting (WRF-3km), and
 - (iv) NCMRWF-Regional Unified Model (NCUMR-4km)

- (d) Yes. Artificial Intelligence (AI) is being used to improve weather, climate, and ocean forecasting skills at various institutes under the ministry. MoES has established a dedicated AI virtual center tasked with developing and testing multiple AI techniques and capacity-building activities by conducting workshops and conferences. A computing environment and virtual workspace for training and deploying AI models have been established at IMD. Achievements and outcomes of AI and machine learning (ML) in the research and development of weather prediction are provided below:
 - Improved the short-range precipitation forecast in 1-day, 2-day, and 3-day lead times with a reduction in bias
 - Developed high-resolution (300 meters) urban gridded meteorological datasets for temperature and precipitation
 - Developed the time-varying Normalized Difference Urbanization Index with a spatial resolution of 30 meters from 1992-2023
 - Developed very high-resolution precipitation datasets for verification purposes
