

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 2287
ANSWERED ON 20/03/2025

SUPERCOMPUTERS ARKA & ARUNIKA

2287. DR. PARMAR JASHVANTSINH SALAMSINH:
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SHRI NARAYANA KORAGAPPA:

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

- (a) the manner in which the supercomputers Arka and Arunika would improve the accuracy of weather forecasting and disaster prediction in the country;
- (b) the initiatives being undertaken to train the meteorologists and scientists in using AI-powered climate prediction models;
- (c) whether Government has set any targets for reducing forecasting errors with the use of Arka in the coming years;
- (d) whether there are any specific Government-backed programmes that will utilize Arunika's computational power to optimize fisheries, marine bio-diversity, or deep-sea exploration; and
- (e) 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) The Ministry of Earth Sciences (MoES) provides weather forecasting services to the nation using several numerical weather prediction (NWP) models. These models are run routinely at different temporal and spatial scales on supercomputers to support operational weather forecasts. This activity requires state-of-the-art computational resources. So, the supercomputers (Arka and Arunika) are crucial to improving the accuracy of weather forecasts by running high-resolution NWP models with a high volume of observational datasets into the latest data assimilation methods to improve model initial conditions further.

For example, the current resolution of models used for short and medium range weather forecasts is inadequate for block-level forecasts. To achieve accuracy in weather forecasts, we need to increase model resolutions from 12.5 km to 6.5 km (short-medium range) and 35 km to 12 km (seasonal). Higher model resolution has demonstrated better predictability skills for extreme events. Increasing the resolution requires computing resources that are eight times greater than the current high-performance computing (HPC) capacity. Therefore, deploying Arka and Arunika will enable operational models to run at much higher resolutions than currently possible with the existing HPC, thereby enhancing the predictability of forecasting extreme weather events such as heat and cold waves, cyclones, heavy rainfall, floods, thunderstorms, lightning, etc. across the country.

- (b) The enhanced computational capability helps to efficiently use new advanced technologies such as artificial intelligence (AI) and machine learning (ML) to enhance the accuracy of NWP products further, thereby significantly improving the forecast products rendered to various stakeholders, including disaster preparedness. The Ministry of Earth Sciences explores integrating AI and ML technologies into weather forecasting systems in addition to physics-based numerical models. This initiative is part of a broader strategy to enhance the accuracy and efficiency of meteorological predictions nationwide. To further strengthen, Indian scientists are collaborating with international programs such as "Momentum Partnership" to improve AI capability in weather and climate predictions.

The Ministry has established a dedicated virtual center on AI/ML/Deep Learning (DL) at the Indian Institute of Tropical Meteorology (IITM) in Pune. A dedicated functional group has been established in IMD under the MoES to strengthen the R&D activities in AI/ML. These centers focus on leveraging AI, ML, and DL techniques for advancements in Earth Sciences. It has already developed several AI/ML-based applications tailored for localized predictions and the analysis of weather and climate patterns. Achievements and outcomes of AI and ML in the research and development (R & D) 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 (300m) urban gridded meteorological data sets 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 data sets for verification purposes.
- Deep Learning approach is being explored for precipitation nowcasting using data from DWRs.

- (c) Yes.

- (d)-(e) The MoES has launched various missions that focus on improving different components of earth - ocean sciences for a weather - aware society, which helps to optimise fisheries, maintain marine biodiversity, and also in deep-sea exploration. The core computing capacity provided by Arunika and Arka shall be extensively used for these purposes.
