GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. 3087
ANSWERED ON 19/03/2026

PROMOTION OF RESEARCH AND CAPACITY BUILDING

3087. SHRI PRAMOD TIWARI:

Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether Government has taken due note of the climate change across States;
(b) if so, the initiatives taken to promote earth science research and capacity building;
(c) the steps taken for detection and monitoring of all-weather hazards across the country; and
(d) the details of customisation of bulletins and warnings related to landslides and extreme weather events?

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

(a)-(b) Yes. The Government has taken due note of the climate change across the country. The Ministry of Earth Sciences (MoES), Government of India, through its Climate Change report titled "Assessment of Climate Change over the Indian Region" (https://link.springer.com/book/10.1007/978-981-15-4327-2), has assessed the impact of climate change across the country. Since the middle of the twentieth century, India has witnessed a rise in average temperatures; a decrease in monsoon precipitation; an increase in extreme temperature and rainfall events, droughts, and sea levels; and an increase in the intensity of severe cyclones. The India Meteorological Department (IMD) publishes an annual climate summary for each State during the first quarter of each year, which is available publicly at the IMD Pune website (imdpune.gov.in).

The Government has undertaken multiple initiatives to advance Earth science research, capacity building, and educational infrastructure across the country. Dedicated institutes under the MoES e.g., IMD, Indian Institute of Tropical Meteorology (IITM), National Centre for Medium Range Weather Forecasting (NCMRWF), Indian National Centre for Ocean Information Services (INCOIS), National Centre for Coastal Research (NCCR), National Centre for Seismology (NCS), National Centre for Polar and Ocean Research (NCPOR), National Institute of Ocean Technology (NIOT), Centre for Marine Living Resources & Ecology (CMLRE), National Center for Earth System Sciences (NCESS) are advancing research in the interactions between the atmosphere, oceans, and polar systems, focusing on their role in regional climate

dynamics and extreme weather patterns. IITM leads the flagship capacity-building initiative under MoES, the Development of Skilled Manpower in Earth System Sciences (DESK) program, with the objective of developing academic habits through training on targeted areas and semester-based coursework in Earth Sciences. Efforts are also being made to strengthen the scientific community's capacity in climate science and assessment through training programs, workshops, and knowledge exchanges, ensuring that India has the necessary expertise to understand and respond to the complex climate challenges.

(c)-(d) The Ministry of Earth Sciences has developed advanced early warning systems for severe weather events such as cyclones, heavy rainfall, droughts, and other extreme conditions. Early warning for severe weather events is supported by a state-of-the-art observation network that includes surface and upper-air observations, remote sensing, seamless forecasting systems based on high-resolution dynamical models, and GIS-based tools for generating alerts and warnings. The entire system is integrated with modern telecommunication technologies to ensure the timely and effective dissemination of information.

Recently, the India Meteorological Department, in coordination with other centres in the MoES, has developed an end-to-end GIS-based Decision Support System (DSS), which has been working as the front end of the early warning systems for the timely detection and monitoring of all-weather hazards across the country, including the States regularly affected by cyclones and other natural disasters. It is supported with specific severe weather modules to provide timely impact-based early warnings for extreme weather events like cyclones, heavy rainfall, droughts, etc., which devastate human lives, livelihoods, and infrastructure. The system utilizes historical data, including extreme events, as well as real-time surface and upper-air meteorological observations available for the Indian region and its neighbouring areas. It also includes radar observations, available every 10 minutes, and satellite products every 15 minutes. It also uses numerical weather prediction products from a suite of models run in the MoES institutions. These include hyperlocal, regional, and global models. Further, IMD plays a crucial role in safeguarding lives and property through its advanced observational network and forecasting systems, enabling timely preparedness and response in close collaboration with the National Disaster Management Authority (NDMA). This coordinated approach ensures that accurate and timely weather information reaches authorities and the public, enhancing disaster risk reduction efforts across the country.

The Geological Survey of India (GSI), under the Ministry of Mines, has been mandated to issue regional landslide forecasts/early warnings based on rainfall thresholds. Currently, GSI issues operational/experimental daily regional landslide forecast bulletins to 21 districts in 08 (eight) States during the monsoon period. GSI's landslide forecast model is primarily based on rainfall thresholds derived from historical rainfall and landslide occurrence data, in conjunction with daily rainfall forecast data received from institutions under the Ministry of Earth Sciences. These bulletins forecast information on the possibility of occurrence of landslides up to the taluk/sub-divisional level daily for the next 48 hours.

The India Meteorological Department has adopted new techniques and technology from time to time to detect, monitor, and provide timely early warnings for the entire country, including the States regularly affected by all types of extreme weather events like cyclones, heavy rainfall, droughts, etc., which have devastating impacts on human lives, livelihoods, and infrastructure. There has been significant progress in this direction with:

- Strengthening of the observing system with installation of additional AWS, ARG, and DWR, etc.
- Improvement of the data integration and development of GIS-based DSS.
- Improvement of NWP models and climate models, as well as a real-time seamless monitoring, forecasting, and early warning system.
- Shifting from conventional weather forecast and warning to sector-specific color-coded Impact-based forecast (IBF) and risk-based warning (RBW) up to district/sub-city levels with dynamical impact and risk matrix
- Application of AI/ML
- Customisation of bulletins and warnings
- Substantial increase of computational power to integrate voluminous data and to run meso-scale, regional, and global models at a further higher resolution scale with improvement of process understanding and model physics. Supercomputers (Arka and Arunika) are being used for this purpose.
- Panchayat Mausam Seva.
- A state-of-the-art dissemination system with the use of a mobile app, Common Alerting Protocol (CAP), WhatsApp groups, etc.
- IMD developed a mobile App, 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination, and 'Damini' for lightning alerts.

IMD has also brought out a web-based "Climate Hazard & Vulnerability Atlas of India" prepared for the thirteen most hazardous meteorological events, which cause extensive damage and economic, human, and animal losses. The same can be accessed at https://imdpune.gov.in/hazardatlas/abouthazard.html. The atlas provides information that may assist State Government authorities and disaster management agencies in identifying potential hotspots and in planning appropriate measures to address extreme weather events. The product also serves as a reference for efforts related to climate-resilient infrastructure planning.

IMD has taken various initiatives in recent years for improvement in data reception and dissemination of weather forecast and warning services based on the latest tools and technologies. It includes the dissemination of forecasts and warnings through the website, email, SMS, and Social Media Platforms such as YouTube, Facebook, X, and Instagram. The India Meteorological Department has developed various mobile apps for the dissemination of weather-related warnings, such as

- MAUSAM App for weather forecasting and warnings
- MEGHDOOT App for agro met services
- DAMINI App (developed by IITM) for lighting warning
- UMANG App (developed by MeitY) for Weather forecasting and warnings

Additionally, the India Meteorological Department follows necessary steps and action in coordination with the NDMA and Centre of Development of Telematics (C-DOT) for the dissemination and communication of the warnings. As per Standard Operating Procedure (SOP), IMD is generating Common Alerting Protocol (CAP) alerts using the SACHET platform for severe weather events like Heavy Rainfall, Lightning, Thunderstorm, Dust storm, etc. These alerts are disseminated by the State Disaster Management Authority (SDMA) to geo-targeted users via SMS. These alerts are also disseminated through the SACHET website and SACHET mobile app. IMD's CAP feeds are also disseminated to the Global Multi-Hazard Alert System (GMAS), Google, AccuWeather, and Apple.

IMD has developed an API (Application Programming Interface), which is being used by various private and public organisations for further dissemination of IMD's forecasts and warnings to the general public through different media, including mobile apps developed by different stakeholders. It shares all severe weather forecasts and warnings, e.g., short to medium-range forecasts and Warnings are disseminated to the State Administration through emails on a regular basis. (Chief Secretary, State disaster management Authority, District disaster management Authority, Media). Warnings are also shared through WhatsApp Groups of Administration (State-level disaster management groups).

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