



## Mains Practice Question

**Q.** How can emerging technologies in weather forecasting and climate modeling help India better prepare for climate change impacts? Discuss with examples. **(150 words)**

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### Approach

- Introduce the answer by briefing the vulnerability of India to climate risks
- Give the Role of Emerging Technologies in Climate Resilience
- Suggest Measures to Further Strengthen the Role of Emerging Technologies in Climate Resilience
- Conclude by summing up key points and forward looking approach.

### Introduction

According to the **Global Climate Risk Index**, in 2019 India was the world's seventh most vulnerable country to the impacts of climate change. Emerging technologies like **Artificial Intelligence (AI), satellite-based remote sensing, high-resolution climate models, and IoT-based early warning systems** are enhancing India's ability to predict, adapt to, and mitigate climate risks.

### Body

#### Role of Emerging Technologies in Climate Resilience

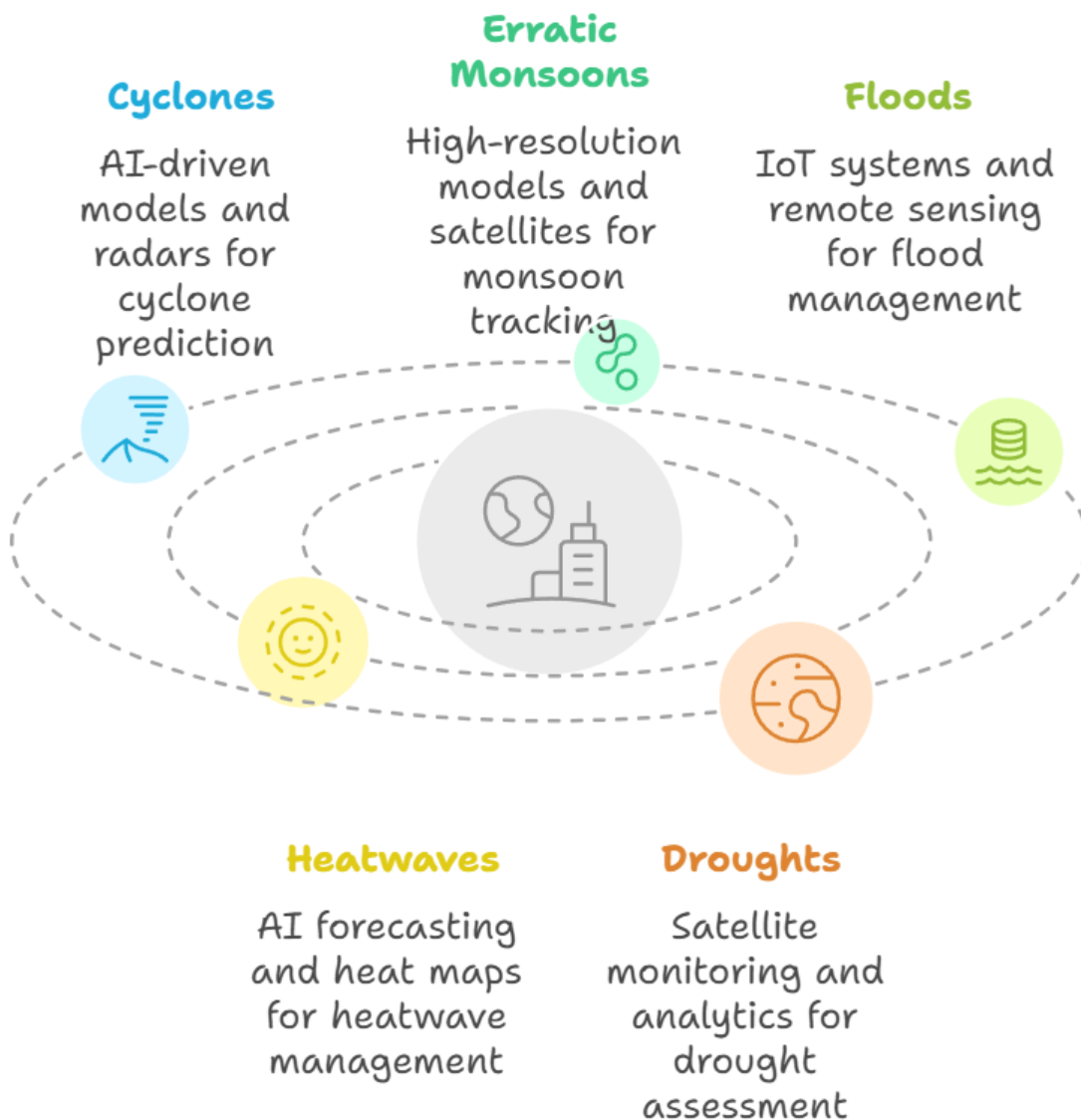
- **Improved Weather Forecasting for Disaster Preparedness:** Advanced forecasting technologies provide **early warnings** for extreme weather events, helping authorities take proactive measures.
  - **Artificial Intelligence (AI) and Machine Learning (ML):** AI-driven models analyze vast climate datasets to **detect patterns in monsoon variability, cyclonic formations, and heatwaves.**
    - ML improves the **accuracy of short-term and long-term weather predictions.**
    - **Example:** In collaboration with NASA, **IBM is releasing an open-source foundation model** that can be customized for a variety of weather and climate-related applications.
  - **Doppler Weather Radars (DWR):** Doppler radars provide **high-precision short-term forecasts** for thunderstorms, heavy rainfall, and lightning.
    - These are crucial for **preventing flash floods and urban flooding.**
    - As of 2023, there are 39 Doppler Weather Radars (DWRs) well distributed across the country to monitor severe weather events.
- **High-Resolution Climate Models for Long-Term Planning:** Climate models simulate future climate trends, aiding in **policy formulation and infrastructure development.**
  - **Regional Climate Models (RCMs) and Global Climate Models (GCMs)** help predict **temperature trends, monsoon patterns, and sea-level rise.**
    - These assist in designing **climate-resilient urban infrastructure and agricultural policies.**
- **Satellite-Based Remote Sensing for Real-Time Monitoring:** Satellites provide **continuous**

**monitoring of climatic parameters**, enhancing early warning systems.

- **Geostationary and Polar-Orbiting Satellites** monitor **cyclones, rainfall patterns, ocean temperatures, and deforestation rates**.
  - Help in predicting **floods, droughts, and desertification trends**.
  - **INSAT-3DR satellite** provides **real-time cyclone tracking**, aiding disaster response efforts.
- **Big Data, Cloud Computing, and IoT for Early Warning Systems:** Technology-driven **data analytics and automation** improve the speed and accuracy of climate risk assessments.
  - Enables **faster processing of climate simulations**, enhancing risk assessments.
  - Supports **real-time decision-making** during extreme weather events.
- **IoT-Based Sensor Networks: Automated weather stations** provide hyperlocal data, improving real-time forecasting.
  - IoT sensors detect **lightning activity, soil moisture, and temperature fluctuations**.
  - For instance, The Damini Lightning Alert App, developed by IMD, sends **real-time lightning warnings**, reducing casualties in rural areas.

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## Technological Responses to Climate Challenges



## Measures to Further Strengthen the Role of Emerging Technologies in Climate Resilience:

- **Strengthening AI & ML Integration in Forecasting** - Collaborate with global AI research institutions to enhance prediction accuracy.
- **Expanding Doppler Radar Network** - Deploy more **Doppler radars** in climate-sensitive regions like **Northeast India**.
- **Developing Indigenous Climate Models** - Reduce dependency on foreign models by **investing in Indian-developed high-resolution models**.
- **Enhancing Public Awareness and Warning Systems** - Improve accessibility of real-time climate alerts through mobile apps like **Mausam App**.
- **Increasing IoT-Based Weather Infrastructure** - Deploy **automated weather stations** in rural and agricultural zones to provide **hyperlocal forecasts**.

## Conclusion

Emerging technologies are **transforming India's climate resilience strategies** by enhancing forecasting accuracy, strengthening disaster preparedness, and supporting long-term policy planning. Integrating AI, satellite monitoring, Doppler radars, and IoT-based systems will be **crucial for safeguarding lives, infrastructure, and livelihoods** against the growing threats of climate change. A **technology-driven climate adaptation approach** is key to ensuring India's sustainable future in a warming world.

PDF Reference URL: <https://www.drishtias.com/mains-practice-question/question-8652/pnt>

