"MISSION MAUSAM: WEATHER RESILIENCE FOR A SUSTAINABLE FUTURE" -PAPER I

Introduction

India is one of the most climate-vulnerable countries in the world, with a long history of facing extreme weather events such as cyclones, floods, droughts, and monsoons. The impact of these climatic challenges on agriculture, infrastructure, and human lives has been significant. Climate change is exacerbating these threats, making it imperative for India to develop robust weather management systems that can mitigate the adverse effects of extreme weather and enhance climate resilience. Against this backdrop, the Union Cabinet, chaired by Prime Minister Narendra Modi, approved "Mission Mausam" — a groundbreaking initiative aimed at strengthening India's ability to predict and respond to extreme weather events and climate change.

Mission Mausam is an ambitious project with a budget of ₹2,000 crore over two years. It will leverage state-of-the-art technology, including next-generation radars, satellite systems, and high-

performance supercomputers, to develop highly precise weather and climate information systems. The mission will benefit multiple sectors, including agriculture, disaster management, defence, aviation, energy, and tourism, while also enhancing India's overall climate resilience.

Key Objectives of Mission Mausam

The primary objective of Mission Mausam is to improve India's capacity to observe, understand, and predict weather patterns and extreme weather events. This includes enhancing the country's ability to deliver highly accurate and timely weather information across various temporal and spatial scales. The mission will focus on several critical aspects, including:

1. **Monsoon Monitoring:** The Indian monsoon is a lifeline for the country's agricultural sector, which directly impacts the livelihoods of millions of people. Mission Mausam aims to improve the accuracy of monsoon predictions, ensuring better water resource management, agricultural planning, and drought preparedness.

2. **Air Quality and Extreme Weather Events:** Air quality is a pressing issue in India, especially in urban areas. Mission Mausam will integrate air quality monitoring into its broader framework, providing accurate forecasts for pollution levels. Additionally, the mission will focus on predicting extreme weather events such as cyclones, floods, and heatwaves to minimize their impact on people and infrastructure.

3. **Weather Interventions:** The mission will explore innovative weather interventions to manage issues like fog, hail, and rain. These interventions are critical for sectors such as aviation, transportation, and agriculture, where weather-related disruptions can cause significant economic losses.

4. **Integration of Advanced Technology:** A key feature of Mission Mausam is its reliance on next-generation technologies. This includes deploying advanced radars and satellite systems equipped with cutting-edge sensors, as well as leveraging artificial intelligence (AI), machine learning (ML), and high-performance supercomputing to model and predict weather systems with unprecedented accuracy.

Institutional Collaboration

Mission Mausam will be primarily implemented by three key institutions under the Ministry of Earth Sciences (MoES) — the India Meteorological Department (IMD), the Indian Institute of Tropical

Meteorology (IITM), and the National Centre for Medium-Range Weather Forecasting (NCMRWF). These institutions will work together to enhance the country's weather surveillance, modelling, forecasting, and management systems.

Supporting institutions under MoES, such as the Indian National Centre for Ocean Information Services (INCOIS), the National Centre for Polar and Ocean Research (NCPOR), and the National Institute of Ocean Technology (NIOT), will provide additional expertise and resources. This collaborative approach ensures that Mission Mausam will benefit from a wide range of knowledge and technological capabilities, positioning India as a global leader in weather and climate management.

Significance for Key Sectors

The success of Mission Mausam will have far-reaching implications for several critical sectors in India:

1. **Agriculture:** Indian agriculture is highly dependent on monsoon rains, which are often unpredictable. Improved weather forecasting through Mission Mausam will help farmers make informed decisions about planting, irrigation, and harvesting, thereby boosting crop yields and reducing the risk of crop failure due to adverse weather conditions.

2. **Disaster Management:** India faces frequent natural disasters such as cyclones, floods, and landslides, which cause widespread damage to life and property. With better weather forecasting and real-time data sharing, Mission Mausam will enhance disaster preparedness and response, enabling authorities to evacuate vulnerable populations and minimize loss of life.

3. **Defence and Aviation:** Extreme weather conditions can disrupt military operations and civil aviation. Mission Mausam's accurate weather predictions will support these sectors by providing reliable data on weather patterns, allowing for better planning and risk management during operations.

4. **Energy and Water Resources:** Energy production, especially in sectors like hydropower and solar energy, is closely linked to weather conditions. Mission Mausam's enhanced weather monitoring will ensure more efficient energy management, including the optimization of energy grids based on predicted weather patterns. Additionally, improved

monsoon forecasts will aid in the management of water resources, preventing both droughts and floods.

5. **Tourism:** Weather plays a significant role in tourism, particularly in India, where destinations like hill stations and coastal regions are prone to extreme weather conditions. With better weather forecasts, the tourism industry will be able to plan and manage visitor safety more effectively, ensuring a seamless experience for travellers.

Technological Advancements in Weather Management

One of the standout features of Mission Mausam is its emphasis on the integration of advanced technologies to improve weather forecasting. Some of the key technological innovations that will be deployed under the mission include:

1. **Next-Generation Radars and Satellite Systems:** These systems will be equipped with advanced sensors capable of capturing detailed weather data in real-time. This will enhance India's ability to track and predict weather systems, improving the accuracy of short- and long-term forecasts.
2. **High-Performance Supercomputers:** High-performance computing is essential for processing vast amounts of weather data and running complex models to simulate weather patterns. Mission Mausam will deploy supercomputers to process data quickly and provide highly accurate forecasts.
3. **Artificial Intelligence and Machine Learning:** AI and ML will be used to analyze weather data, identify patterns, and make predictions. These technologies will improve the precision of weather forecasts, enabling authorities to respond to extreme weather events more effectively.
4. **GIS-Based Automated Decision Support System:** Geographic Information Systems (GIS) will be integrated into the mission to provide real-time data sharing and automated decision-making. This will help stakeholders make informed decisions about managing weather-related risks in real time.

Long-Term Impact of Mission Mausam

In the long run, Mission Mausam will help India build a more resilient society, capable of tackling the challenges posed by climate change and extreme weather events. By improving weather

forecasting and response systems, the mission will reduce the economic and social impact of natural disasters, saving lives and protecting livelihoods.

Furthermore, the mission will enhance India's research and development capabilities in atmospheric sciences, making the country a global leader in weather surveillance and climate change management. By integrating advanced observation systems, high-performance computing, and AI-driven forecasting, India will set a new benchmark for weather prediction, benefiting not just its own citizens, but also contributing to global efforts to combat climate change.

Conclusion

Mission Mausam represents a significant step forward in India's efforts to strengthen its weather and climate management capabilities. By leveraging cutting-edge technology and fostering collaboration across key institutions, the mission will improve the accuracy and timeliness of weather forecasts, helping the country better respond to extreme weather events and the impacts of climate change. The mission's success will benefit multiple sectors, from agriculture and disaster management to defence, aviation, and tourism. As climate change continues to pose significant challenges to India's growth and development, Mission Mausam will play a critical role in ensuring a resilient and sustainable future for the nation.

Main Practice questions

1. **Explain the significance of Mission Mausam in improving India's weather management capabilities. What are the key technological advancements introduced under this mission, and how do they contribute to weather prediction and climate resilience?**

2. **Analyze the role of Mission Mausam in strengthening disaster management and resilience across multiple sectors in India. How will this initiative enhance decision-making in agriculture, urban planning, and infrastructure development?**

Question 1:

Explain the significance of Mission Mausam in improving India's weather management capabilities. What are the key technological advancements introduced under this mission, and how do they contribute to weather prediction and climate resilience?

Answer Guidelines:

1. **Introduction**: Briefly explain the purpose of Mission Mausam, highlighting its goal to enhance India's ability to predict and respond to extreme weather events.

2. **Significance of Mission Mausam**:
   ➢ Discuss how the mission addresses India's vulnerability to climate change and extreme weather.
   ➢ Mention the sectors that benefit from the mission, such as agriculture, disaster management, defence, and aviation.

3. **Key Technological Advancements**:
   ➢ Next-generation radars and satellite systems: How they improve real-time weather data collection and short- and long-term forecasts.
   ➢ High-performance supercomputers: Their role in processing vast weather data and running complex weather models.
   ➢ Artificial Intelligence (AI) and Machine Learning (ML): Discuss how these technologies help in identifying weather patterns and improving the accuracy of forecasts.
   ➢ GIS-based automated decision support systems: How this technology helps with real-time data sharing and decision-making for various stakeholders.

4. **Conclusion**: Summarize the long-term impact of these technologies on improving India's climate resilience and ability to manage extreme weather events.

Question 2:

Analyze the role of Mission Mausam in strengthening disaster management and resilience across multiple sectors in India. How will this initiative enhance decision-making in agriculture, urban planning, and infrastructure development?

Answer Guidelines:

1. **Introduction**: Briefly introduce Mission Mausam's focus on disaster management and its relevance to India's increasing exposure to climate-related disasters.

2. **Strengthening Disaster Management**:

➢ Discuss how better weather forecasting will help authorities prepare for extreme weather events like cyclones, floods, and heatwaves.

➢ Highlight the role of real-time data in enabling quicker evacuation and emergency response measures.

3. **Sector-Specific Benefits**:

➢ **Agriculture**: Explain how accurate monsoon predictions will improve water resource management, cropping patterns, and food security.

➢ **Urban Planning**: Discuss how enhanced weather data can help in flood-resistant infrastructure design, better land use, and drainage systems.

➢ **Infrastructure Development**: Address how weather predictions will inform long-term infrastructure projects, ensuring resilience against extreme weather.

4. **Conclusion**: Conclude by summarizing the overall benefit of Mission Mausam in enhancing decision-making and building climate resilience in various sectors across India.