# *"MISSION MAUSAM"*

# *MINISTRY OF EARTH SCIENCES*

## Background:-

Tropical weather presents a significant challenge to forecast due to its inherent complexity. The demand for weather and climate forecast information has grown rapidly and will increase even faster in the coming years in view of growing extreme weather, climate, water, and other environmental risks.

To improve our ability to forecast weather accurately, we need more detailed observations, a better understanding of various physical processes, and advanced numerical models that incorporate these processes.

Frontier developments and technologies offer a remarkable possibility to make a quantum leap in observing and modeling the Earth system to offer value-added services to the nation. These include new observing systems such as next-generation radars, satellites with advanced instrument payloads, high-performance computers (HPC) and storage systems, improved Earth system models, and data-driven methods to achieve "Panchayat-level" weather forecasts.

Our observations are relatively sparse both in terms of spatial and temporal coverage. Moreover, the horizontal resolution of the Numerical Weather Prediction (NWP) models is 12 km, making it difficult to accurately forecast small-scale weather events in India. Though there has been significant improvement in forecast accuracy in the short to medium range up to 5 days (about 40-50% improvement in accuracy during the past decade as compared to the previous decade), there is still scope to improve the forecast further. Similarly, there is scope to improve the lead period and service delivery to all socio-economic sectors and stakeholders.

Moreover, as climate change progresses, the atmosphere is becoming more chaotic. This leads to phenomena like isolated heavy rainfall events and localized droughts, creating simultaneous challenges of both flooding and drought. The cloudburst, intense thunderstorms, lightning, and squalls are least understood over the Indian region. Understanding these complex patterns demands an in-depth knowledge of physical processes within clouds, outside clouds, on the surface, and in the upper atmosphere, over the oceans, and in the Polar regions. This necessitates (a) high-frequency observations both at the ground level and throughout the Earth system (atmosphere, ocean, and polar regions) with improved spatial and vertical resolutions to effectively monitor and document Earth's dynamic systems, and (b) improvement of the horizontal resolution of the NWP model from 12 km to 6 km to generate forecasts at the Panchayat level.

Due to ever-growing improvement in socio-economic conditions, the role of weather and climate in various sectors like urban development, health, and the environment is very important. Research and development are essential to

understand the processes, predict accurately, and develop weather and climate applications.

Considering the above, “Mission Mausam” as a national initiative has been taken up by the Ministry of Earth Sciences for implementation during 2024-2026. The Union Cabinet, chaired by the Honourable Prime Minister, has approved ‘Mission Mausam’ with an outlay of Rs. 2,000 crore over two years.

## Aims and Objectives:

The multi-faceted transformative approach, namely “Mission Mausam,” has the goal of making Bharat a "Weather-ready and Climate-smart" nation to mitigate the impact of climate change and extreme weather events and strengthen the resilience of communities.

The Phase-I of Mission Mausam will be implemented during 2024-26. The Phase-II of Mission Mausam will be implemented during 2026-31 in the next financial cycle.

The objectives of the proposed “Mission Mausam” include:

- Developing cutting-edge weather surveillance technologies and systems.
- Implementing higher-resolution atmospheric observations with better temporal and spatial sampling/coverage.
- Deploying next-generation radars and satellites with advanced instrument payloads.
- Establishing high-performance computing (HPC) systems.
- Improving understanding of weather and climate processes and enhancing prediction capabilities.
- Developing improved earth system models and data-driven methods (use of AI/ML).
- Creating technologies for weather management.
- Developing a state-of-the-art dissemination system for last-mile connectivity.
- Fostering capacity building.

## Strategy:

The mission envisages using advancements in observational technology to document weather phenomena over the nation and surrounding regions with higher precision and resolution. The radical changes brought to the mission are through seven verticals, bridging the gaps and leading the way for services. Basic deliverables of “Mission Mausam” are:

- Establishment of 50 DWRs, 60 RS/RW, 100 disdrometers, 10 Wind Profilers, 25 radiometers, 1 Urban testbed, 1 Process testbed, 1 Ocean Research station, 10 Marine AWS with upper air observation.
- National field campaign.
- Data assimilation of the additional data from DWRs, RS/RW, etc.

- Next-generation satellite instruments.
- Development of land surface models and cloud microphysics using testbed observations.
- AI/ML tool development for improving weather forecasts.
- Evaluating the existing observing network and preparing quality-controlled datasets for model verification.
- Model forecast intercomparison and verification.
- Development of a nowcast system for weather services, which can provide rapid updates every 1 hour.
- Improving quantitative precipitation forecasts (QPF) for river basins and major cities.
- Model forecast verification across scales.
- Collaboration with IAF for instrumented aircraft (cyclone studies).
- Acquisition of Uncrewed Aircraft Systems.
- Installation of new atmospheric chemistry instruments and air quality monitoring.
- Augmentation of the Solar Radiation Monitoring Network.
- Decision Support System for advisories and visualization nodes for HQ and Regional Meteorological Centres.
- Rain enhancement experiments, cloud seeding drone and ground-based burner experiments.
- Technology development for seeding and delivery methods; drones, flares (collaboration).
- First phase of a cloud chamber.
- Numerical simulations to fine-tune seeding methods.
- Procurement of aircraft for research and seeding (collaborate with IAF).
- MoES-Academia-Industry nexus in capacity building, not restricted to HRD but including technology transfer.
- Implementation of a multi-institutional capacity-building program involving all stakeholders.
- Starting incubation centres.
- Initiating a centralized pool of mega facilities for atmosphere and ocean research.

## Target Beneficiaries

- The current services will be further improved by converting planned research and developments into fully operational products, services, and effective means to develop linkages with decision-makers and users.
- The beneficiaries include the general public, national and state-level disaster management authorities, and sectors like Agriculture, Civil Aviation (Airport Authority, Airline operators), Water resources, Power, Renewable Energy, Tourism, Sports and Pilgrimage, Smart Cities, Ports and Harbours, Road transport, Railways, Shipping, onshore and offshore operators (Oil

exploration, etc.), Health service providers, Defence Services, urban sector, environment, academia and research and development institutes, Central and State Pollution Control Boards, and many other sectors.

- There is a need for a GIS-based Automated Decision Support System. The level of uncertainty of different weather conditions needs to be communicated. Outreach through Mobile Apps, Websites, social media, etc., along with awareness about the complexity of weather to society, is essential.

**Implementation Mechanism:**

- The Mission Mausam will be implemented mainly by the India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM), and the National Centre for Medium-Range Weather Forecasting (NCMRWF). IMD will mainly focus on observations, services, decision support systems, and dissemination. The Indian Institute of Tropical Meteorology (IITM) will focus on specialized field campaigns, research testbeds, process studies, and modeling. The National Centre for Medium-Range Weather Forecasting (NCMRWF) will focus on data assimilation and seamless weather prediction.
- The other MoES institutes, namely the Indian National Centre for Ocean Information Services (INCOIS), National Institute of Ocean Technology (NIOT), and National Centre for Polar and Ocean Research (NCPOR), will complement the Earth system observations in the oceans and polar regions, respectively.
- The Mission will have linkages with other institutes like the Central Water Commission (CWC), Geological Survey of India (GSI), and Defence Geoinformatics Research Establishment (DGRE), which have mandates for flood forecasting, landslides, and avalanches, respectively.
- The Mission will also have strong collaboration with other national laboratories, academia, and industries.

Outcomes:

- To capture all the weather events happening in the country, so that no weather system will go undetected.
- Improve the frequency of nowcasting from 3 hours to 1 hour.
- Improved air quality forecasts for all smart cities and enhanced the air quality forecasts by about 5-10% in the major metro cities.
- Improve the short- and medium-range weather forecast accuracy by about 5-10%.
- Decision Support System will help in automation and enhancement of forecast accuracy.
- Easy access and delivery of weather- and climate-related data to stakeholders, academia, and researchers.

- Quicker reception of all the satellite data, without time delay, for assimilation of data into the weather and climate models.
- Enhanced forecast accuracy across various:
    a) Timescales—from short-term (a few days) to medium-range (10 to 15 days), extended range (one month), and seasonal forecasts.
    b) Space scales up to Panchayat level (5-6 km) for medium-range forecasts.
- Implement weather intervention for fog dispersal, hail suppression, and rain enhancement.
- Leadership development to provide top-tier forecasts to other countries in the Global South.
- It will help in the improvement of Impact-Based Forecasting and Disaster Risk Reduction, thus improving the socio-economic conditions of the country.

In summary, transforming our weather and climate observation, understanding, modeling, and forecasting capabilities is crucial for better prediction and management of the impacts of tropical weather and climate change. With comprehensive, high-resolution data and advanced technologies, we can make strides towards a more weather-ready and climate-smart Bharat.