The **National Centre for Medium Range Weather Forecasting (NCMRWF)** is a Centre of Excellence in Weather and Climate Modelling under the Ministry of Earth Sciences. The mission of the Centre is to continuously develop advanced numerical weather prediction systems, with increased reliability and accuracy over India and neighbouring regions through research, development and demonstration of new and novel applications, maintaining highest level of knowledge, skills and technical bases.

Background: NCMRWF was established as a mission mode project of the Government in 1988 with the mandate to provide medium range (3-10 days in advance) location specific forecasts to farmers through development of Agro-Advisory Service for the country. The Centre has implemented and upgraded from time to time a global Numerical Weather Prediction (NWP) system for preparation and dissemination of medium range weather forecasts. This requires the use of voluminous global atmospheric and oceanographic observations, their assimilation to provide initial conditions, numerical models, and high end computing resources. The Centre established a network of Agro-Meteorological Field Units (AMFUs) in the Agro-climatic zones (ACZ) of the country through which agro advisories were issued to farming community. After the successful demonstration of Agro-advisory services in real time, the same has been handed over to India Meteorological Department for the operational use. NCMRWF have also been providing customized weather forecasts for various other socio-economic sectors of the country viz. power, sports and tourism etc. on special request. The forecast products prepared at the Centre has been found to be very useful by these sectors.

Computing Resources: The first Super Computer System in India (Cray XMP/14, 1 processor and 4 MB memory) was dedicated to the Nation at NCMRWF by the then Prime Minister of India in 1989. For carrying out operational and research activities in weather forecasting, NCMRWF always maintains the best supercomputing facility available to meteorological community in the country. The computing facilities of NCMRWF have been updated several times after the successful implementation of Cray XMP/14. NCMRWF also procured various distributed memory systems including Indian indigenous super computing system PARAM, IBM Power 6, Bhaskara and NCMRWF weather forecasting packages were ported on to these parallel processing computers. Recently a 2.8 Peta Flop high performance computing system 'Mihir' and ~ 20 Peta Byte storage has been installed at NCMRWF.

Weather Prediction System: Weather prediction system is based on Numerical weather prediction technique, which uses mathematical models of the atmosphere, oceans and sea ice to predict the weather based on current weather conditions. Atmospheric observations from all over the world are received at NCMRWF through Global Telecommunication System (GTS) of World Meteorological Organization (WMO) via India Meteorological Department (IMD). All these observations are then processed; qualities controlled and assimilate in the global data assimilation system. At present NCMRWF is working as the core atmospheric data assimilation centre for all the constituents of MoES. Based on the initial condition prepared by data assimilation system, global NWP model is integrated forward in time to generate next 10 days weather forecasts. Continuous efforts are being made to increase the reliability and skill of the model predictions through increasing resolution of numerical models, improving representation of physical processes in the model, optimizing use of satellite and other data in the assimilation, extensive verification and validation. Currently the Centre runs a global model for 10 days with about 17 km horizontal resolution and assimilates all available observational data, both in-situ and remote sensing including Indian satellite and radar observations. In addition, regional

models of 4 km and 1.5 km resolutions are also run at NCMRWF for prediction of high impact weather.

Ensemble Prediction System: Weather prediction generally has uncertainty due to small errors in the initial conditions, and model approximations. Together they limit the skill of a deterministic prediction system. Ensemble prediction has emerged as the practical way of estimating the forecast uncertainty and making probabilistic forecasts. Ensemble forecasts are generated based on multiple perturbed initial conditions which sample the errors in the initial conditions to estimate the forecast uncertainty (spread in member forecasts). The skill of the ensemble forecast shows marked improvement over the deterministic forecast when comparing the ensemble mean to deterministic forecast after a short lead time. NCMRWF utilizes ensemble prediction system for probabilistic quantitative precipitation forecast and tropical cyclone track prediction.

All the current activities of NCMRWF are done through four major projects viz.

(i) Numerical Modelling of Weather and Climate (NMWC),

(ii) BIMSTEC Centre for Weather and Climate (BCWC)

(iii) National Monsoon Mission, Phase II

> (a) Interaction of Convective Organization and Monsoon Precipitation, Atmosphere, Surface and Sea (INCOMPASS)
> (b) Bay of Bengal Boundary Layer Experiment (BoBBLE)
> (c) Better understanding of Interregional Teleconnections for prediction in the Monsoon And Poles (BITMAP)

(iv) High Performance Computing Project

First project viz. NMWC is under the programme Atmosphere & Climate Research- Modelling Observing Systems & Services (ACROSS) of the Ministry of Earth Sciences and BCWC is under the programme Research Education and Training Outreach (REACHOUT). Computing facilities of NCMRWF are maintained and upgraded under the project High Performance Computing System (HPCS).