

# India Meteorological Department

## Announcement of Opportunity (AO) for Research in Meteorology

### 1. Introduction

India Meteorological Department (IMD) conducts and promotes R & D in different disciplines of Meteorology. *Main objective of IMD's R & D activities is to improve its services to various users. Due to advancements in the observational techniques and aids like Meteorological Satellites, Radars, Automatic Weather Stations (AWS) etc., a variety of meteorological data and products have become available, which are required to be fully utilised to improve operational weather forecasting. Before doing so, considerable R&D work is required to be carried out to analyse, process and use this voluminous meteorological data for developing suitable forecasting techniques/methods in several new areas of weather prediction and to improve the skills in the existing forecasting system.*

This Announcement of Opportunity (AO) is open to various academic and research institutions in the country which are engaged in research in the field of Meteorology and Atmospheric Sciences for submitting research proposals towards utilisation of Satellite Meteorological data and products of INSAT , KALPANA and other Indian Satellites, Doppler Weather Radar, Wind Profiler, Radiometer, and AWS data alongwith other conventional meteorological data like surface and upper air observations over land and Ship/Buoy data over sea areas.

### 2. Key Research and Development (R&D) Areas

Some of the key areas for this AO are:

#### 2.1. *Monsoon*

To develop techniques/methodologies for

- (a) Seasonal and monthly prediction of rainfall at Meteorological sub divisions and state level
- (b) Extended range (10-20days) predication of rainfall at the state and district level
- (c) Objective criteria for declaring onset/withdrawal of monsoon over various sub divisions
- (d) Objective criteria for break monsoon condition over India
- (e) Prediction of active, break and revival phase of monsoon
- (f) Prediction of genesis and movement of monsoon depressions
- (g) Prediction of heavy rainfall

- (h) **Seasonal and monthly prediction of frequency of monsoonal disturbances over the north Indian Ocean**
- (i) **Structure of monsoon lows and depressions**
- (j) **Location specific prediction of severe weather due to low pressure systems**
- (k) **Interaction of mid-latitude westerly systems with monsoon circulation**

## **2.2. Tropical Cyclones**

To develop techniques/methodologies for

- (a) **Seasonal prediction of cyclone activity (number of cyclones) over North Indian Ocean (NIO) comprising Arabian Sea and Bay of Bengal**
- (b) **Track and intensity prediction of Tropical Cyclones that form in the North Indian Ocean**
- (c) **Reanalysis and reconstruction of best tracks**
- (d) **Structure of north Indian tropical cyclones**
- (e) **Validation of Dvorak's technique over north Indian Ocean**
- (f) **Hydrological aspects of tropical cyclones**
- (g) **Meso-scale features associated with cyclones**
- (h) **Characteristics of landfalling cyclones**
- (i) **Characteristics of cyclones dissipating over the Sea**
- (j) **Location specific prediction of severe weather due to cyclone**
- (k) **Socio-economic impact of cyclones**
- (l) **Role of orography on intensity and movement of cyclones**
- (m) **Interaction of mid-latitude westerlies with the tropical cyclones**
- (n) **Refinement of storm surge prediction with higher lead time with better spatial resolution across over coastal districts of India**

## **2.3. Data Assimilation**

**Assimilation of Satellite, Radar and AWS data into**

- (a) **Global Numerical Weather Prediction (NWP) models**
- (b) **Regional NWP Models**
- (c) **Meso Scale Models**

## **2.4. Satellite Meteorology**

- (a) *Utilisation of INSAT-3D, Oceansat-2, Megha-Tropiques and Saral data*
- (b) *Use of Advanced Dvorak Technique in the determination of intensity of north Indian Ocean cyclones*
- (c) *Satellite –based thunderstorm climatology*
- (d) *To predict genesis, intensity and track of cyclone using satellite products*

## **2.5. Radar Meteorology**

- (i) To develop technique/methodology for validation of Doppler weather radar products:**

**namely,**

- a) Reflectivity PPI\_Z**
  - b) Radial velocity PPI\_V**
  - c) Spectrum width PPI\_W**
  - d) Shear 3DS**
  - e) Layer turbulence LTB**
  - f) Rainfall SRI & PAC**
  - g) Maximum product MAX\_Z**
  - h) Horizontal wind profile VVP\_2**
  - i) Horizontal wind UWT\_2**
  - j) Vertically integrated liquid water content VIL**
- ii) To improve warning of severe weather events and validate the threshold values for warning.**
- iii) To study and draw the structure map of thunderstorm using reflectivity and velocity data of DWR**
- iv) To develop technique/methodology to locate centre of a cyclonic storm in absence of visible formation of 'Eye' and also to estimate radius of maximum wind (RMW) utilizing DWR data.**
- v) To predict intensity and forecast the track of cyclone using DWR data.**
- vi) To develop technique/methodology to eliminate / filter out the non meteorological data from the DWR base data Z, V and W in order to generate quality control radar data.**

## **2.6. Severe Weather (High Impact Weather Events)**

- (a) To improve the skills of warnings in respect of high impact weather events like, floods, droughts, heat waves, cold waves etc.*
- (b) To improve short range prediction skills of severe local storms, heavy rainfall events and fog. Efforts are needed to advance the lead time of forecasts of these high impact weather events.*

- (c) *To develop regional and local climatology of severe weather events.*
- (d) *To develop location specific nowcasting techniques for severe weather events.*

## **2.7. Agro Meteorology**

Improvement of agro-meteorological forecast using satellite derived and other products.

## **2.8. Hydro Meteorology**

(a) *Estimation of Design Storm:-*

- *Compilation of grid point data of total liquid water content in atmosphere with the help of water vapor channels of satellite.*
- *Developing objective criteria to delineate meteorological homogeneous regions*
- *Address the problem of outliers in Return Period Analysis*

(b) *Quantitative Precipitation Forecast (QPF): -*

- *Output of Meso scale models of Numerical Weather Prediction technique to be adequately incorporated for QPF with downscaling techniques.*
- *Quantitative Precipitation Estimates from Satellite and Radar to be suitably customized to warn for flash / urban floods.*

(c) *Glaciology:-*

- *The altitude of snow line to be assessed from remote sensing satellite imageries for past few years particularly the years of low snowfall for the purpose of determining permanent snow line.*

## **2.9. Aviation Meteorology**

- (a) To predict severe weather phenomena / events that are detrimental to aviation, such as, active thunderstorm and severe icing hazard areas, clear air turbulence (CAT), mountain wave, low level wind shear.**
- (b) To provide decision support tools to formulate terminal aerodrome forecast (TAF) and incorporation of probabilistic forecast groups in TAF.**
- (c) To issue TREND type forecast (nowcast) of current weather elements.**

## **2.10 . Marine Meteorology**

To develop techniques/methods for marine forecasting, viz. wave forecasting, ship routing etc.

## **2.11 . Environment Meteorology**

*To develop techniques /methods for air quality prediction the following research problems in Environmental Meteorology have been identified:*

- (a) Radiative forcing of aerosols
- (b) Surface ozone, UV and health impacts
- (c) Air quality forecast modelling
- (d) Environmental impact assessment of developmental projects.
- (e) Quantification of source and sink potential of GHGs using C-cycle modelling
- (f) Assessment of energy potential in the country
- (g) Industrialisation and acid rain threats

## 2.12. Regional Studies

- (a) To develop objective value-addition methods for the utilisation of predictions/forecasts issued by IMD New Delhi and Pune. (Regional Meteorological Centres (RMCs) and Meteorological Centres (MCs) shall collaborate with local academic institutions for developments of techniques for their region / state.)
- (b) To develop region specific forecasting techniques
- (c) To develop regional, state, District and location specific climatology
- (d) Any other region/state specific meteorological study/forecasting problem identified by RMCs and MCs.

## 2.13. Climate Change

*To analyse and study existing meteorological data and undertake sensitivity studies using numerical models to assess climate change impacts on :*

- (a) Southwest Monsoon.
- (b) Northeast Monsoon.
- (c) Frequency and intensity of Tropical Cyclones of Bay of Bengal and Arabian Sea.
- (d) Occurrence of fog.
- (e) Occurrence of Heat Waves/Cold Waves
- (f) Occurrence of Floods/droughts.

### **(d) IMD Offices/Centres :**

Locations and addresses of IMD Offices/Centres are given in Annexure -1.

### **(e) Computing Facilities :**

Computing facilities available at various centres of IMD are listed in Annexure-2.

### **(f) Data availability**

*As per IMD's new data supply policy, effective from 1 April 2009, concerned Universities/Institutes should register with IMD . The registration charge is Rs 5,000/- and annual renewal charge is Rs 1000/-, and then data will be provided to them for research purposes free of cost (with other terms and conditions) .*

## **(g) Evaluation of proposals**

A committee constituted by the Director General, IMD will evaluate the proposals. The committee may suggest amendments/modifications to the proposals, if necessary.

## **7. Terms and conditions**

*7.1 The data sets provided by IMD must be used only for the purpose specified in the proposal. The project personnel do not have right to copy, lease or loan the data without prior permission of IMD. The data will be supplied free of cost and it should not be used for any commercial purposes.*

*7.2 The PIs will make available the salient results and techniques developed to IMD for operational applications.*

*7.3 The PIs will also make available the salient results to the scientific community through publications in appropriate journals. The cost of such publication, if any, in journals / periodicals may have to be borne by the investigators and IMD in no way may reimburse the cost of publications. Copies of all publications resulting from the research project must be submitted to IMD. Acknowledgement of IMD support must be mentioned in all publications.*

*7.4 The PIs are required to submit annual progress reports to IMD during the duration of project. A detailed report is to be submitted at the end of the project.*

## **8. Who can submit a proposal ?**

*Proposal could be submitted by individuals or a group of scientists, academicians and research scholars belonging to recognised institutions and universities. In order to have better co-ordination, it is recommended to have one CO-PI for India Meteorological Department. The proposal must be supported by an undertaking by the Head of the Department / Head of Office in which the investigator(s) is (are) working to the effect that necessary computing and allied facilities would be extended to the investigators to carry out the project(s).*

## **9. Format of the project proposal**

The formats of cover page, project proposal and required declarations are attached.

The proposal may be submitted to **Project Cell, DGM's Secretariat, Mausam Bhavan, Lodhi Road, New Delhi -110003.**

**Locations and addresses of IMD Offices/Centres**

DDGM (Sat.Met.)  
DDGM (UI)  
DDGM (H)

Additional Director General Of Meteorology (Research),  
India Meteorological Department,  
Shivaji nagar,  
Pune-411 005  
E mail : [adgmr@imdpune.gov.in](mailto:adgmr@imdpune.gov.in)  
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Deputy Director General Of Meteorology (W.F.),  
India Meteorological Department,  
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FAX : 091- 020- 25530201

Deputy Director General of Meteorology (Agrimet),  
India Meteorological Department,  
Shivaji nagar,  
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E mail : [agrimet@imdpune.gov.in](mailto:agrimet@imdpune.gov.in)  
TELEPHONE : 020-25535953  
FAX : 091- 020-25535953

Deputy Director General Of Meteorology (Surface Instrument),  
India Meteorological Department,  
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Deputy Director General Of Meteorology (Training )  
Central Training Institute,  
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Dr.Homi Bhabha Road,Pashan, Pune-411 005  
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DDGM, RMC.New Delhi

Dy. Director General of Meteorology,  
Regional Meteorological Centre,  
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Deputy Director General of Meteorology,  
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Regional Meteorological Centre  
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Regional Meteorological Centre  
Civil Airport, Nagpur - 440 005  
TELEPHONE  
FAX



## Annexure-2

### Computing Facilities

Ministry of Earth Science (MoES) has taken initiative to procure High Performance Computing System (HPCS) for its constituent units including IMD in November 2006. The procurement processes are completed in December 2008 and the equipments received in March 2009 for installation at various locations in IMD. The details of the computer system are given in Annexure-2. The system installation and operationalisation of various numerical models are expected to be completed by the end of September 2009 at various locations of IMD. Under this program, IMD HQ., New Delhi is getting computer system with peak speed of Fourteen Terra Flops to run state-of-art numerical models (global as well as regional high resolution models) at various time scales, another system of one Terra Flops speed at IMD, Pune for modelling works related to extended range to seasonal prediction system. In additional, high-end servers are available at 12 major Meteorological Centres (RMCs-Delhi, Mumbai, Chennai, Nagpur, Kolkata, Guwahati, MCs- Ahmedabad, Bangalore, Bhubaneshwar, Chandigarh, Hyderabad and WF Pune) for the works related to regional data base management, mesoscale data assimilation, high resolution nested local modelling (9/3 km) for the regional domain. Statistical downscaling works shall also be carried out for local specific forecast products.

Sl. No.	Item	IMD HQ., New Delhi	IMD, Pune	RMC/MC*
1	HPCS	IBM POWER-6/575 SMP, No. of CPUs: 768, 14.43 Tera Flops peak.	IBM POWER-6/575 SMP, No. of CPUs: 44; 0.827 Tera Flops peak.	NIL
2	High-end Servers (P-570) (134 GFlops Peak, CPUs: 8)	Four	One	One each
3	Visual Workstation (8 GB memory)	Ten	Three	One each
4	Storage online	100TB	50TB	NIL
5	Storage near online	200TB	0TB	NIL
6	Storage Archival (Tape & Disk in 2:1 ratio)	300TB	100TB	NIL
7	External SDLT/LTO4 Tape drives	2 at HQ	1	1 each

\*RMCs-Delhi, Mumbai, Chennai, Nagpur, Kolkata, Guwahati, MCs- Ahmedabad, Bangalore, Bhubaneshwar, Chandigarh, Hyderabad and WF Pune.

## Cover Page of the Proposal

Title of the Proposal

Name and Designation of PI

Telephone, Fax and E-mail Address

Name of Institution with full Address

Signature of PI with Date

Signature of Head of Institution

Next page

1. Title of the Proposal:
2.
  - (a) Name of the Principal Investigator
  - (b) Institution
  - (C) Telephone No.
  - (d) Fax
  - (e) Email
  - (f) Mailing Address:
3. Name of the Co-Principal Investigator
4. Summary of the proposed work
5. Details on the preliminary work done/background experience, if any
6. List of Publication in the related field
7. Description of the project
  - a. Theme
  - b. Objective
  - c. Study area
  - d. Type of data required
  - e. Methodology
  - f. Schedule
  - g. Expected results and its possible use
8. Name of Co-investigator(s) in the AO project (please include bio-data of all investigators)
9. Facilities and equipments available at the institution.

### **Format for Declaration (Principal Investigator)**

We have carefully read the terms and conditions of IMD's AO and agree to abide by them.

We certify that the data provided by IMD would be used only for the intended AO project.

Signature of PI with Name

Designation

It is certified that if the proposal is accepted by the IMD, the facilities as identified in the proposal and administrative support available at our institution will be extended to the Principal Investigator and other Co-investigators to execute the project

Signature of Head of Institution with Name  
and Designation

Date:

Seal of Head of Institution

**Format for Declaration (Co-Principal Investigator)**

We have carefully read the terms and conditions of IMD's AO and agree to abide by them.

We certify that the data provided by IMD would be used only for the intended AO project.

Name

Signature of Co-PI with

Designation

It is certified that if the proposal is accepted by the IMD, the facilities as identified in the proposal and administrative support available at our institution will be extended to the Principal Investigator and other Co-investigators to execute the project

Signature of Head of Institution with Name  
and Designation

Date:

Seal of Head of Institution