WMO OMM

World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

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الرسالة رقم: 13959/2021/MS/ETFD/FEL   25 حزيران/ يونيو 2021

عدد المرفقات: 4 (متوافرة بالإنكليزية فقط)

الموضوع: تدريب جماعي مختلط على التنبؤ العددي بالطقس بمركز التدريب الإقليمي (RTC) التابع للإدارة الهندية للأرصاد الجوية (IMD)، المعهد التدريبي للأرصاد الجوية، مدينة بونا، الهند، في الفترة من 4 تشرين الأول/ أكتوبر إلى 10 تشرين الثاني/ نوفمبر 2021

الإجراء المطلوب: للعلم واتخاذ الإجراء المناسب، حسب الاقتضاء

تحية طيبة وبعد،

أود أن أشير إلى الرسالة التعميمية للمنظمة (WMO) رقم 00597/2021/MS/ETFD، المؤرخة 28 كانون الثاني/ يناير 2021، بشأن فرص التعليم والتدريب التي تتيحها المنظمة (2021)، ومفادها أن المنظمة (WMO) ستنظم في عامي 2021 و2022 تدريباً جماعياً مختلطاً على التنبؤ العددي بالطقس (NWP) في مختلف أقاليم المنظمة (WMO) وبلغاتها الرسمية.

وتستهدف الدورة الموظفين الذين يرتبط عملهم بالتنبؤ العددي بالطقس (NWP)، وستزودهم بالمعارف والمهارات العملية في هذا المجال. وتتألف الدورات المختلطة من جزأين، هما الجزء الإنترنتي وجزء المتابعة داخل مقر مركز التدريب الإقليمي (RTC) في 2022 عندما تسمح الظروف. سيركز الجزء الإنترنتي أساساً على الجانب النظري، بينما سيعزز الجزء داخل المركز (RTC) المعرفة النظرية، وسيتناول التدريب العملي على المنهج الدراسي، والذي يمكن أن يكون صعب التقديم عبر الإنترنت.

ويسرني أن أبلغكم أنه بعد مناقشات مكثفة مع المركز (RTC)، سيعقد الجزء الأول الإنترنتي من التدريب الجماعي المختلط على التنبؤ العددي بالطقس (NWP) في المركز (RTC) في بونا في استضافة الإدارة (IMD) في الفترة من 4 تشرين الأول/ أكتوبر إلى 10 تشرين الثاني/ نوفمبر 2021. وستجري فعاليات الدورة بالإنكليزية، دون رسوم دراسية.

ويرجى من أعضاء المنظمة (WMO) في الاتحاد الإقليمي الثاني تسمية مرشحين للدورات المصممة خصيصاً لبناء قدرات موظفي تقديم الخدمات. ولضمان جودة التعليم، يرجى من الأعضاء تسمية ما يصل إلى ثلاثة مرشحين. ونشجع النساء والرجال على السواء على تقديم طلبات. وينطوي الترشيح على الالتزام بضمان توفر المشاركين على حضور جميع الدورات المباشرة، وتخصيص الوقت الكافي لهم لاستكمال جميع وحدات الدراسة الذاتية. ومن المتوقع أن يكون الالتزام الزمني لكل مشارك حوالي 20 ساعة في الأسبوع لحضور الجلسات المباشرة واستكمال وحدات وتمارين الدراسة الذاتية. وسيحتاج كل مشارك إلى حاسوب مكتبي أو محمول شخصي موصول بالإنترنت بشكل يُعتمد عليه، مما يسمح بتدفق الفيديو والصوت، إضافة إلى التوصيل بالخوادم البعيدة لاستكمال وحدات الدراسة الذاتية.

إلى: الممثلين الدائمين لأعضاء الاتحاد الإقليمي الثاني (توزيع محدود)

صورة إلى: المستشارين الهيدرولوجيين

ويرجى ملاحظة أن المشاركين داخل المركز (RTC) سيُختارون من بين المشاركين في الجلسة الإنترنتية فقط. وسيُوافى المشاركون المختارون بإخطار في الوقت المناسب.

وينبغي للمرشحين أولاً تقديم طلب إلى المركز (RTC) في بونا باستيفاء استمارة الترشيح الخاصة بالإدارة (IMD) (المرفق الرابع)، وإرسال الاستمارة إلى الدكتور Somenath Dutta (dutta.drsomenath@gmail.com) والسيد Shri. R. K. Giri (rk.giriccs@gmail.com)، في موعد أقصاه **4 آب/ أغسطس 2021** للحصول على خطاب القبول، ثم موافاة المنظمة (WMO) باستمارة الترشيح للمنحة، وإرسال خطاب القبول إلى fel@wmo.int في موعد أقصاه **3 أيلول/ سبتمبر 2021**. وترد في المرفقات الأول والثاني والثالث خطة تفصيلية عن الدورة والمعلومات ذات الصلة. ويرجى ملاحظة أن الترشيحات السابقة لهذه الدورة لا تزال صالحة، ولا حاجة لإرسالها مجدداً.

وأود أن أعرب لكم عن تقديري لدعمكم المستمر لأنشطة المنظمة (WMO).

وتفضلوا بقبول فائق الاحترام،

البروفيسور بيتيري تالاس
الأمين العام

Meteorological Training Institute, India

	Host Member	India
1	Host institution(s)	Government of India, Ministry of Earth Sciences India Meteorological Department Meteorological Training Institute WMO RTC Pune component in India
2	Website	https://www.imdpune.gov.in/training/training.html
3	Location(city) of Institution(s)	Pashan, Pune
4	Address of Institution	Meteorological Training Centre (MTI) IMD Colony Campus Dr Homi Bhaba Road Pashan, Pune, Pin 411008, Maharashtra State
5	Course type	Online and follow-up on-campus course
6	Main course content	• History & Hierarchy of NWP • Numerical methods • Spectral method • Data assimilation • Physical Parameterization • Operational forecast models • Interpretation and application of NWP output
7	Duration of study	6 weeks. Follow-up on-campus course. Hands-on Practical: 2 weeks
8	Course start date	4 October – 10 November 2021 (online) TBD (on-campus course)
9	Target Region and Members	WMO Regional Association II Developing Members
10	Basic Requirements	Meteorologist with BSc degree or equivalent, with 2-year work experience
11	Language	English
12	Number of awards	30 Follow-up on-campus course: 15
13	Institution Online application	Optional
14	Admission from Institution	Mandatory
15	Application forms sent to WMO	1. WMO FNF 2. Pre-admission letter from host institution
16	Closing date for applications	RTC: 4 August 2021 WMO: 3 September 2021
17	Contact info	Dr Somenath Dutta Head, Meteorological Training Centre (MTI) India Meteorological Department, Pashan, Pune-411008, India Email: dutta.drsomenath@gmail.com, and Dr R.K. Giri Head, Organization India Meteorological Department Mausam Bhavan, Lodi Road, New Delhi-110003 Email: rk.giriccs@gmail.com

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**Joint IMD-WMO group fellowship training course on
Numerical Weather Prediction
through distance learning**

**Managed by the Meteorological Training Institute,
India Meteorological Department (IMD), Pune**

4 October—10 November 2021

Course Description

Predicting weather phenomenon with reasonable accuracy crucially depends on numerical weather prediction (NWP) with all of its components, such as data assimilation, physical parameterization, numerical integration, post processing, etc. The recent phenomenally accurate prediction of extreme weather events like the Super Cyclonic Storm *AMPHAN* in India has again proved this. Hence meteorological personnel engaged in weather forecasting should have reasonable a knowledge and skill on different aspects of NWP. They must be capable of understanding, interpreting and applying different NWP products more appropriately with full confidence. They must be able to appreciate the scientific reason for the change in accuracy in an NWP forecast, due to certain tuning in the NWP model. This can only be achieved by systematically designing, conducting and participating in training in NWP. This training course has been designed with forecasting personnel in mind and efforts have been made to maintain the standards of the Basic Instruction Package for Meteorologists (BIP-M).

Expected Learning Outcomes

Participants who successfully complete this training course:

- Will understand the concept of an initial and boundary value problem and appreciate that the problem of weather forecasting is so;

- Will learn about the history and hierarchy of NWP models;

- Will know and understand different numerical methods and the spectral method for solving the governing equations, along with their difficulties, like linear and nonlinear instability;

- Will understand different data assimilation methods;

- Will understand different schemes for parameterizing important physical processes;

- Will understand different NWP models along with some knowledge of the basics of developing an NWP model;

- Will understand the uncertainty in an NWP forecast and know how to interpret ensemble predictions;

- Will be able to understand, interpret and apply different NWP products appropriately.

Ref.: 15394/2021-1.0 GS

Target Audience and Qualifications

Forecasters from RA II Members who have successfully completed a BIP-MT course and have a Batchelor of Science degree (BSc) — with Physics and Mathematics as main subjects.

Course Content

The event shall consist of online lectures/presentations on certain broad themes and online practical exercises. Each participant shall prepare a review for presentation of a research paper of their choice, on any aspect of NWP. The broad themes to be discussed are given below:

- History and hierarchy of NWP
- Numerical Methods,
- Spectral method,
- Data assimilation,
- Physical Parameterization,
- Operational forecast models,
- Interpretation and application of NWP output and a practical exercise.

At the end of the course trainees will be examined by an MCQ-type test and their participation will be certified based on the results of that text.

Course Format

Online lectures/presentations on certain broad themes, hands-on exercises.

Last date for receipt of nominations

Nominations from the PR must reach:

- Dr. Somenath Dutta (email: dutta.drsomenath@gmail.com), with a copy to Dr R.K. Giri (email: rkgiriccs@gmail.com)

no later than 21 August 2021 along with the REGISTRATION FORM duly completed by the nominated participants.

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**Joint IMD-WMO group fellowship Training Course
on Numerical Weather Prediction**

Meteorological Training Institute, India Meteorological Department (IMD), Pune

4 October to 10 November 2021

Mode: Online (Synchronous & Asynchronous)

Tentative Agenda

(Time Zone : UTC+5:30)

4 October 2021: 1430-1530 - Inauguration		
Week I **Day 1: 4 October 2021** **Theme - Introduction**		
Time	**Session**	**Speaker**
1545-1645	1. Basic concept of an initial value problem. Well posed and ill posed initial value problems. 2. Limitation in traditional synoptic method, demand for a location and time-specific forecast system, giving rise to the concept NWP.	Dr S. Dutta, IMD
1700-1800	3. Potential of NWP system to give location and time-specific forecast. 4. A generic structure of an NWP system. 5. History and Hierarchy of NWP	Dr S. Dutta, IMD
Day 2: 5 October 2021 **Theme - Numerical method**		
Time	**Session**	**Speaker**
1430-1530	1. Discussions on different types of differential equations and how governing equations are non-linear partial differential equations.	Dr S. Dutta, IMD
1545-1645	2. Difficulties in getting analytical or exact solutions of such equations. Alternative approaches — Numerical methods and Spectral method.	Dr S. Dutta, IMD
1700-1800	3. Different finite difference schemes (FDS), viz., forward, backward and leapfrog schemes.	Dr S. Dutta, IMD

	Week I (cont'd) Day 3: 6 October 2021 Theme - Numerical method	
Time	**Session**	**Speaker**
1430-1530	1. Compatibility of FDS. 2. Explicit and implicit or semi implicit time differencing schemes.	Dr S. Dutta, IMD
1545-1645	3. Lax equivalence theorem. 4. Numerical approximation of Jacobian and Laplacian. Concept of Arakawa's 9 point Jacobian.	Dr S. Dutta, IMD
1700-1800	5. Stability analysis of numerical solution using linear advection equation for explicit and implicit time differencing schemes. 6. CFL criteria and its physical interpretation. Numerical solution of linear advection equation using leapfrog scheme.	Dr S. Dutta, IMD
	Day 4: 7 October 2021 Theme - Spectral method	
1430-1530	1. Basic concepts of orthogonal function, Spherical harmonics and orthogonal polynomial. Basic properties of Legendre polynomial.	Dr R. Krishnan, Scientist G, IITM
1545-1645	2. Spectral representation of Meteorological field variable. Spectral co-efficient, spectral transform. Basic concepts of spectral method.	Dr R. Krishnan, Scientist G, IITM
1700-1800	3. Triangular and Rhomboidal truncation.	Dr R. Krishnan, Scientist G, IITM
	Day 5: 8 October 2021 Theme - Data assimilation	
1430-1530	Definition of objective analysis, its importance and its different types, Viz., Cressman method, Optimum interpolation method, BLUE, Maximum likelihood estimate. To show that BLUE is same as maximum likelihood estimate and is the best estimate.	Dr S. Dutta, IMD
1545-1645		
1700-1800		

Ref.: 15394/2021-L.0 GS

	Week II Day 1: 11 October 2021 Theme - Data assimilation	
Time	**Session**	**Speaker**
1430-1530	Different formats of data and their interchangeability. Decoding and quality control of GTS conventional/non-conventional observations, processing of non-GTS (satellite radiance) observations, Grid Statistical Interpolation (GSI) scheme, Concept of observation operator.	Scientists from NCMRWF
1545-1645		
1700-1800		
	Day 2: 12 October 2021 Theme - Data assimilation	
1430-1530	Basic concept of a general data assimilation cycle, Variational data assimilation (3D-Var and 4D-Var). Introduction to cost function for 3D-VAR as well as for 4D-VAR data assimilation and its minimization, giving rise to analysed field. Concept of Kalman filtering.	Scientists from NCMRWF
1545-1645		
1700-1800		
	Day 3: 13 October 2021 Theme - Data assimilation	
1430-1530	1. Basic concept of a general data assimilation cycle, Variational data assimilation (3D-Var and 4D-Var). Introduction to cost function for 3D-VAR as well as for 4D-VAR data assimilation and its minimization, giving rise to analysed field. Concept of Kalman filtering.	Scientists from NCMRWF
1545-1645	2. Processing Doppler Radar Data for quality control and mesoscale data assimilation. Oceanic data assimilation: data assimilation at mesoscale, assimilation of altimetry data.	
1700-1800	3. Ensemble data assimilation technique, Hybrid data assimilation technique.	
	Day 4: 14 October 2021 Theme - Data assimilation	
1430-1530	Definition of initialization, its importance and its different types, viz., Static Dynamic, Normal mode, Dynamic normal mode and Physical, Nudging, Synthetic data generation/vortex initialization.	Scientists from NCMRWF
1545-1645		
1700-1800		
	Day 5: 15 October 2021 Theme - Parameterization of physical processes	
1430-1530	1. Definition with example of subgrid scale physical processes and their influence on grid scale variable. Definition of parameterization of subgrid scale physical processes and explain its importance. 2. Different subgrid scale physical processes, viz., SWR, LWR, Cumulus/convective parameterization, Orographic drag, eddy transport in PBL.	Scientists from IITM, Pune
1545-1645		
1700-1800		

Ref.: 15394/2021-L0 GS

Week III **Day 1: 18 October 2021** **Theme - Parameterization of physical processes**		
Time	**Session**	**Speaker**
1430-1530	Dry and moist adiabatic adjustment process. Different cumulus parameterization schemes, Viz., Kuo, Arakawa, BM, KF schemes, etc., their broad aspects, benefits and limitations and intercomparison.	Scientists from IITM, Pune
1545-1645		
1700-1800		
Day 2: 19 October 2021 **Theme - Parameterization of physical processes**		
1430-1530	1. Principle of radiative transfer. Gravity wave drag and its parameterization Biosphere and Land surface processes. Parameterizations of air-sea interaction processes. 2. PBL parameterization under different stratification. Concept of mixing length, Von Kerman constant, roughness length, Monin Obukov length, etc.	Scientists from IITM, Pune
1545-1645		
1700-1800		
Day 3: 20 October 2021 **Theme - Parameterization of physical processes**		
1430-1530	PBL parameterization under different stratification. Concept of mixing length, Von Kerman constant, roughness length, Monin Obukov length, etc.	Scientists from IITM, Pune
Day 4: 21 October 2021 **Theme - Types of Dynamical models**		
1545-1645	1. Primitive equation model with different vertical coordinates, viz., p, sigma, terrain following, eta, etc. Representation of orography in a model.	Dr S. Dutta, IMD
1700-1800	2. Derived model, viz., barotropic model, equivalent barotropic model, two-layer baroclinic model and quasi geostrophic model.	Dr S. Dutta, IMD
Day 5: 22 October 2021 **Theme - Operational forecasting models**		
1430-1530	Global Forecast System model and Global ensemble forecast system model.	Dr Durai, IMD and Dr P.S. Mukhopadhyay, IITM, Pune
1545-1645		
1700-1800		

Ref.: 15394/2021-L0 GS

Time	Session	Speaker
Week IV **Day 1: 25 October 2021** **Theme - Operational forecasting models**		
1430-1530	1. Global Forecast System model and Global ensemble forecast system model.	Dr Durai, IMD and Dr P.S. Mukhopadhyay, IITM, Pune
1545-1645	2. Couple Model (Climate Forecast system), Ensemble prediction system, multimodel ensemble technique, Extended range forecasting.	Scientists from IITM, Pune
1700-1800		
Day 2: 26 October 2021 **Theme - Operational forecasting models**		
1430-1530	1. Couple Model (Climate Forecast system), Ensemble prediction system, multimodel ensemble technique, Extended range forecasting.	Dr D.R. Pattanaik, IMD
1545-1645		
1700-1800	2. Regional and mesoscale forecast system models (WRF, ARPS), Nowcast model	Dr Soma Sen Roy and Dr A.K. Das, IMD
Day 3: 27 October 2021 **Theme - Operational forecasting models**		
1430-1530	Regional and mesoscale forecast system models (WRF, ARPS), Nowcast model	Dr Soma Sen Roy and Dr A.K. Das, IMD
1545-1645		
1700-1800		
Day 4: 28 October 2021 **Theme - Operational forecasting models**		
1430-1530	Antarctica model Polar WRF, Air quality model WRF (Chem)	Dr V.K Soni and Dr A.K. Das, IMD
1545-1645		
1700-1800		
Day 5: 29 October 2021 **Theme - Operational forecasting models**		
1430-1530	1. Antarctica model Polar WRF, Air quality model WRF (Chem)	Dr V.K. Soni and Dr A.K. Das, IMD
1545-1645	2. Cyclone model Hurricane WRF, vortex relocation and initialization	Scientists from NWP division IMD
1700-1800		

Week V
Day 1: 1 November 2021
Theme - NWP Products (Understanding, interpretation and application)

Time	Session	Speaker
1430-1530	Direct (basic field variables) and Derived (vorticity/its tendency, divergence, vertical velocity, wind shear/its tendency, differential vorticity advection, thermal advection, moisture advection, vertically integrated moisture flux, total precipitable water, etc.) products, their interpretation and application.	Scientists from NWP division, IMD, New Delhi
1545-1645		
1700-1800		

Day 2: 2 November 2021
Theme - NWP Products (Understanding, interpretation and application)

Time	Session	Speaker
1430-1530	1. Direct (basic field variables) and Derived (vorticity/its tendency, divergence, vertical velocity, wind shear/its tendency, differential vorticity advection, thermal advection, moisture advection, vertically integrated moisture flux, total precipitable water, etc.) products, their interpretation and application.	Scientists from NWP division, IMD, New Delhi
1545-1645	2. NWP products for aviation services, hydrological services, NWP products for localized severe weather, monsoon rainfall prediction, prediction of Western disturbances. NWP-based objective cyclone forecast system, NWP-based location specific forecast, GIS application for NWP.	Scientists from NWFC, IMD, New Delhi
1700-1800		

Day 3: 3 November 2021
Theme - NWP Products (Understanding, interpretation and application)

Time	Session	Speaker
1430-1530	1. NWP products for aviation services, hydrological services, NWP products for localized severe weather, monsoon rainfall prediction, prediction of Western disturbances. NWP-based objective cyclone forecast system, NWP-based location specific forecast, GIS application for NWP.	Scientists from NWFC, IMD, New Delhi
1545-1645		
1700-1800	2. Post processing of model output: Model output verification: Forecast skills, Forecast errors, Systematic errors. 3. Down scale of NWP model like location-specific forecast, Statistical interpretation.	Scientists from NCMRWF, Delhi

Day 4: 4 November 2021
Theme - NWP Products (Understanding, interpretation and application)

Time	Session	Speaker
1430-1530	1. Post processing of model output: Model output verification: Forecast skills, Forecast errors, Systematic errors. 2. Down scale of NWP model like location-specific forecast, Statistical interpretation.	Scientists from NCMRWF, Delhi
1545-1645		
1700-1800		

Day 5: 5 November 2021
Theme - Review presentation by participants

Time	Session	Speaker
1430-1530	Presentation of review of a research paper (Duration 10 minutes)	By the participants of each country
1545-1645		
1700-1800		

Week VI Day 1: 8 November 2021 Theme - Review presentation by participants		
Time	**Session**	
1430-1530	Presentation of review of a research paper (Duration 10 minutes)	By the participants of each country
1545-1645		
1700-1800		
Day 2: 9 November 2021 Theme - Review presentation by participants		
1430-1530	Presentation of review of a research paper (Duration 10 minutes)	By the participants of each country
1545-1645		
1700-1800		
Day 3: 10 November 2021 Theme – Evaluation of Training		
1430-1530	MCQ type test of 30 marks	By the participants of each country
1545-1645	Feedback session	By the participants of each country
1700-1800	Valedictory programme	

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13959/2021/MS/ETFD/FEL, ANNEX IV

Joint IMD-WMO group fellowship Training Course on Numerical Weather Prediction (online)

Meteorological Training Institute, India Meteorological Department (IMD), Pune
4 October to 10 November 2021

REGISTRATION FORM

1.	Full name (expanding the initials)	:	
2.	Nationality	:	
3.	Date of birth	:	
4.	Male/Female	:	
5.	Parents name and nationality	:	
6.	Present Address	:	
7.	Email Id and WhatsApp mobile number	:	
8.	Educational qualification	:	
9.	Details of Meteorological training, if any.	:	
10.	Whether previously trained in India? If so, give detail of same	:	
11.	Current post held	:	
12.	Name and full address of Employer including country ZIP	:	
13.	Area of specialization and field of study	:	
14.	Working Experience in terms of years.	:	
15.	Signature of the candidate	:	
16.	Signature of the PR of the country with WMO, along with recommendation	:	

*Please return this form to Dr Somenath Dutta, India Meteorological Department, by email (dutta.drsomenath@gmail.com) with a copy to Dr Shri. R. K. Giri (rkgiriccs@gmail.com) **no later than 21 August 2021**.*

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