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

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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Annexes: 3 (disponibles en anglais seulement)

Objet: Formation collective mixte sur la prévision numérique du temps au Centre régional de formation professionnelle du Service indonésien de météorologie, climatologie et géophysique (BMKG), Indonésie

Suite à donner: Pour information et mesures à prendre, le cas échéant

Madame, Monsieur,

Je souhaite me référer à la lettre circulaire de l'Organisation météorologique mondiale (OMM) datée du 28 janvier 2021 (réf. 97/2021/MS/ETFD) concernant les offres de formation de l'OMM (2021). Dans cette lettre, l'OMM indique qu'en 2021 et 2022, elle organisera des formations collectives mixtes sur la prévision numérique du temps dans différentes Régions de l'OMM et dans les langues officielles de l'Organisation.

La formation s'adresse au personnel dont le travail a trait à la prévision numérique du temps, car elle permettra aux participants d'acquérir des connaissances et des compétences pratiques dans ce domaine. Elles sera composée de deux parties: une première partie en ligne suivie d'une deuxième partie sur le campus, dans les locaux du Centre régional de formation professionnelle (CRFP). La partie en ligne sera principalement axée sur la théorie; celle sur le campus permettra de consolider les connaissances théoriques et de dispenser un enseignement pratique qu'il est difficile de donner à distance.

J'ai le plaisir de vous informer qu'à l'issue de discussions approfondies avec le CRFP, la première partie en ligne de la formation collective mixte sur la prévision numérique du temps au Centre régional de formation professionnelle hébergé par le Service indonésien de météorologie, climatologie et géophysique (BMKG), aura lieu du 20 mai au 2 juillet 2021. Le cours se déroulera en anglais.

Les Membres de la Région V de l'OMM sont invités à désigner des candidats pour suivre des cours destinés à renforcer les capacités du personnel de prestation de services. Afin de garantir la qualité de l'enseignement, les Membres sont invités à proposer jusqu'à trois candidats. La formation s'adresse aussi bien aux femmes qu'aux hommes. Il convient de s'assurer que les participants désignés seront disponibles pour suivre tous les cours en direct et qu'ils disposeront du temps nécessaire pour terminer tous les modules d'auto-apprentissage. Chaque participant doit prévoir environ 20 heures par semaine pour assister aux cours en direct et arriver au bout des modules et exercices d'auto-apprentissage. Par ailleurs, chaque participant doit avoir accès à un ordinateur individuel ou un ordinateur portable, avec une connexion internet fiable, qui permet la diffusion de vidéos et de sons, ainsi qu'une connexion à des serveurs à distance pour suivre les modules d'auto-apprentissage.

Veuillez noter que seuls les participants qui auront suivi la session en ligne pourront être sélectionnés pour la partie de la formation dispensée sur le campus. Les participants sélectionnés seront informés en temps voulu de la session sur le campus.

Aux: Représentants permanents des Membres de la Région V

cc: Conseillers en hydrologie

Les candidats doivent d'abord envoyer au CRFP Indonésie le formulaire de candidature à la formation collective mixte sur la prévision numérique du temps (annexe III) à l'adresse apply.rtcbmkg@bmkg.go.id au plus tard le **7 mai 2021** pour obtenir la lettre d'admission, qu'ils enverront à l'OMM accompagnée du formulaire de candidature à une bourse de perfectionnement à l'adresse fel@wmo.int au plus tard le **14 mai 2021**. Le plan de cours détaillé et les informations connexes figurent dans les annexes I et II.

En vous remerciant du soutien que vous apportez aux activités de l'OMM, je vous prie d'agréer, Madame, Monsieur, l'expression de ma considération distinguée.

Petteri Taalas
Secrétaire général

THE AGENCY FOR METEOROLOGY, CLIMATOLOGY AND GEOPHYSICS (BMKG), INDONESIA

1	**Host Member**	**Indonesia**
2	Host institution(s)	WMO Regional Training Centre, Indonesia
3	Website	https://pusdiklat.bmkg.go.id/
4	Location(city) of Institution(s)	BMKG Training Facility-Citeko,West Java BMKG HQ-Kemayoran, Jakarta STMKG-Tangerang
5	Address of Institution	The Agency for Meteorology, Climatology and Geophysics (BMKG), Kemayoran, Jakarta
7	Course type	Online Course Possible follow-up on-campus course
8	Main course content	1. Introduction to NWP Application 2. Ubuntu Linux System Operation 3. NWP Basic 4. Consortium for Small-scale Modelling (COSMO) 5. Weather Research and Forecasting (WRF) Model 6. Post-Processing Application and Visualization 7. Verification Techniques 8. WRF Simulation in High Performance Computing (HPC) 9. Advance WRF Model 10. Ocean Model 11. Climate Model 12. Application on NWP Products in BMKG Daily Weather Forecast
9	Duration of study	Six weeks Possible follow-up on-campus course
10	Course dates	20 May – 2 July 2021 (Online) TBD (on-campus course)
11	Target Region and Members	WMO Regional Association V Developing Members
12	Basic Requirements	Meteorologist with BSc degree or equivalent, with 2-year working experiences

13	Language	English
14	Number of awards	30 Possible follow-up on-campus course: 15
15	Institution Online application	Optional
16	Admission from Institution	Mandatory
17	Application forms send to WMO	1. WMO FNF 2. Pre-admission letter from host institution
18	Applications close date	7 May 2021
19	Contact info	Ms Ratih Prasetya Email: apply.rtcbmkg@bmkg.go.id; ratih.prasetya@bmkg.go.id

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COURSE INFORMATION AND SYLLABUS

Title of course

Training on the Enhancement of Numerical Weather Prediction (NWP), Indonesia

Course background and description

WMO Regional Association V (RA V) Member countries/territories are located in areas vulnerable to severe weather phenomena such as tropical cyclones, droughts, floods and prolonged heavy rain, which adversely affect their economies and societies. Reliable NWP is essential to improve weather early warning forecasts.

The training programme will be conducted in two stages – an online course and an on-campus course – and its structure has been chosen to best ensure the desired learning outcomes are achieved and successfully implemented to improve operational weather services in participants' respective countries/territories, particularly with respect to improving NWP capacity.

The online course will consist of the transfer of knowledge and skills designed to improve participants' competency in NWP high-resolution products using the Weather Research and Forecasting (WRF) model. It will be focus on mesoscale phenomena and dynamics, provide an overview of the Consortium for Small-scale Modelling (COSMO) system, discuss verification techniques, provide an introduction to the WRF model utilization and to NWP ocean models.

Following the online course, on-campus courses (when these are not prevented by travel restrictions) will focus on hands-on training to enable participants to develop their own NWP capacity to be implemented in their respective countries/territories according to their needs. The training will consist of Ubuntu Linux operation, model physical parameterizations utilizing the WRF model as principal tool, and practical sessions on NWP product applications for weather forecast operations.

Learning outcomes

The goal of this course is to enable participants to develop their own NWP capacity to be implemented in their respective countries/territories based on their needs. Participants are expected to be able to enhance their country's/territory's capacity for NWP by applying NWP models for the tropics region of the WRF model (operation, analysis and interpretation) in operational weather service with high resolution.

Association with standards

The course is associated with the following standards:

- Basic Instructional Package for Meteorological Technicians (BIP-MT) as described in *Guide to the Implementation of Education and Training Standards in Meteorology and Hydrology* (WMO-No. 1083);
- As described in *Technical Regulations, Basic Documents No. 2, Volume I – General Meteorological Standards and Recommended Practices* (WMO-No. 49);
- As accredited by the Meteorology, Climatology and Geophysics Agency (BMKG).

Course objectives

Job competencies to be addressed by the training according to the WMO Competency Framework for Public Weather Service Forecasters and Advisers are the following. Participants will be able to:

- Demonstrate a knowledge of NWP basics
- Demonstrate the ability to display NWP products utilizing R Program and GrADS software
- Use advanced WRF techniques for data analysis and interpretation
- Use NWP models to forecast hazardous weather phenomena and parameters

Desired learning outcomes of the course, written as measurable learning objectives, are that participants will be able to:

- Understand the use and benefits of operational NWP
- Apply Linux basic commands
- Operate the WRF model to simulate extreme weather
- Display output from the WRF model utilizing R Program
- Process ensemble from WRF model output
- Identify extreme weather parameters from the output of advanced post-processing

Target audience and qualifications

The primary audience will be meteorologists (in number 30 for the online course, and 15 for an on-campus course) from RA V countries/territories. Participants should have at least a bachelor of science degree or have an equivalent level of academic background. They are expected to have at least two years of experience as meteorologists, have basic knowledge and skills of NWP modelling, be preferably under the age of 35 years and have an adequate command of spoken and written English.

Programme overview

- The online course will run from **20 May to 2 July 2021**, with a total duration of 6 weeks.
- The on-campus course (when international travel is possible) will be of approximately 5 weeks duration, located in Regional Training Centre facilities in Citeko, West Java; the State College of Meteorology, Climatology and Geophysics (STMKG), Tangerang, Java; and BMKG headquarters in Jakarta.

Language used

This course will be conducted in English.

Application and selection processes

1. The applicant should be nominated by the permanent representative of WMO in his/her country/territory.
2. The nominated candidates are requested to follow the application procedure indicated below under “Deadline for application and contact”.
3. Applicants who receive the award letter from WMO and admission notices from BMKG can participate in the training course.

Deadline for application and contact

Applications have to be sent to both WMO and BMKG. Candidates should first apply to RTC Indonesia with the BMKG Application form (see Annex III) and send the form to apply.rtcbmkg@bmkg.go.id no later than **7 May 2021** to acquire the admission letter, then send to WMO the Fellowship Nomination Form (FNF) and the admission letter to fel@wmo.int no later than **14 May 2021**.

Summary of content

No.	Online course (20 May–2 July 2021)
1.	Building learning commitment
2.	General NWP atmospheric models
3.	NWP basics
4.	NWP applications: Analysis and interpretation of tropical cyclone and extreme weather
5.	NWP applications: Analysis and interpretation of volcanic ash and forest fire
6.	Overview of the COSMO model
7.	Verification techniques
8.	WRF introduction: Models and applications
10.	Introduction to the high performance computing (HPC) unit
11.	Introduction to Ocean modelling: Wave model products
12.	Introduction to Ocean modelling: Hydrodynamics model products

	On-campus course (when possible)
1.	Ubuntu Linux system operation (a) Installation procedure (b) Basic commands
2.	WRF model (a) WRF model introduction and application (b) WRF model parametrization (c) WRF installation (d) WRF simulation procedure (e) WRF simulation of extreme weather events
3.	Post-processing application and visualization (a) Application of post-processing WRF model using GrADS, VAPOR and R Program (b) Displaying WRF model (c) Interpreting WRF products to identify weather parameters
4.	WRF simulation in HPC
5.	Advanced WRF model (a) WRF data assimilation (b) WRF ensemble (c) WRF tropical cyclone
6.	Application of NWP products in BMKG daily weather forecasts (practical session)

Course content

Introduction to NWP applications

Describe the NWP applications for analysis and interpretation of tropical cyclone and extreme weather

- Tropical cyclone trajectory, stage and location
- NWP products for tropical cyclone and extreme weather: ECMWF, Global forecast system (GFS), WRF, ACCESS and WRF TC
- Weather physical parameterization: Cloud cover, sea surface temperature, wind speed and direction, mean sea level pressure, rainfall distribution, rainfall accumulation (hourly, daily), rain rate, cloud type and horizontal wind speed and direction
- Stability index: Convective available potential energy (CAPE), lifting index (LI), K-index, Showalter index
- Convergence and divergence area and value
- Vorticity, vertical velocity and mixing ratio value

Describe the NWP application for analysis and interpretation of volcanic ash and forest fire

- NWP products for volcanic ash and forest fire detection: WRF-Fire and WRF-Chem
- Types of aerosol: SO_2, NO_2, ice particles and ash
- Volcanic ash and fire event location
- Ash and smoke dispersion

Ubuntu Linux system operation

Understand Ubuntu Linux system operation

- Basic operating system concepts: Features and benefits of Ubuntu
- Ubuntu Linux installation procedure
- Ubuntu Linux file system: Understand Ubuntu Menus, managing files and folders, location (path) of files and folders
- Ubuntu Linux basic commands

NWP basics

· Recall the principles and concepts of NWP
· Recall unreliability of NWP
Factors behind potential NWP unreliability: Errors in initial conditions, differences between model atmosphere and actual conditions, computing limitations, chaos in non-linear terms in NWP modelling and butterfly effects

· Recall the NWP equation
· Describe the types of NWP models
- Grid point models
- Spectral models
- Hydrostatic models
- Non-hydrostatic models

COSMO

· Describe COSMO model introduction
· Describe COSMO model application

WRF model introduction and application

Describe WRF modelling system

- Two dynamical cores of WRF: Advanced research WRF (ARW) for research and non-hydrostatic mesoscale model (NMM) for operational
- Benefits of using WRF
- WRF parametrizations: Radiation transferred through the atmosphere, planetary boundary layer and surface layer, cumulus convection, microphysics of clouds and precipitation, and interaction with earth surface
- WRF applications: Parametrization research, case studies, short-range forecast, data assimilation etc.
- WRF types and versions
- WRF standard initialization: Inputs (grids location/levels, terrain/land-use, gridded fields (GRIB)

- WRF global model data: GFS, final analysis (FNL) global data assimilation system (GDAS) and ECMWF models
- WRF modelling system components
- WRF application function (WPS, WRF RUN, ARW POST)

WRF installation procedure

- Understand the required components for WRF-ARW version 4.0 software installation
- Pre-installation
  - Compiling the module and creating libraries
  - Building the WRF code
  - Building the WPS code
- Demonstrate the steps of WRF-ARW version 4.0 software installation
  - Checking the required libraries
  - WPS installation steps (configure-compile)
  - Setting the name list (domain, geogrid, data initial, etc)
  - Running the WPS
  - WPS outputs
- Demonstrate the WRF-ARW running process
  - Checking the required libraries
  - WRF installation (configure-compile)
  - Setting the name list (time step, parameterizations, nesting, etc.)
  - WRF outputs
- Demonstrate ARW post installation and identify the errors
  - Checking the required libraries
  - ARW post installation steps (configure-compile)
  - Setting the name list (input, output, plot etc)
- Identify and solving error issues

WRF simulation procedure

- Able to configure and prepare the WRF-ARW version 4.0 (before running simulations)
- Demonstrate the simulation steps
  - Data initial downloads
  - Setting the domain and name list
  - Running procedure
  - Plotting the output
- Identify weather parameters through extreme weather simulation (a case study)

Post-processing application and visualization

- Demonstrate application of post-processing WRF model using GrADS, VAPOR and R Program function and language
  - Introduction to GrADS, VAPOR and R Program
  - Software installation, basic commands, general scripts (gs), visualizations, saving files, troubleshooting
  - Interpreting WRF products to identify the weather parameters: Rainfall distributions, clouds (type, height and radius), temperatures, and wind speed and direction

Verification techniques

- Using eyeball and contingency table verification techniques to evaluate the WRF output for exp. rainfall accumulation
- Using statistics verifications techniques to evaluate WRF output: Root mean squared error (RMSE), mean absolute error (MAE) and scatter plot

WRF simulation in HPC

- Understand the HPC unit
  - Benefits of using HPC
  - HPC components (hardware and software)
  - HPC architecture
  - Parallel computing: OPEN message passing interface (MPI) and MPICH)
- Able to install and run WRF in HPC

Advance WRF model

- Understand technique (3Dvar and 4Dvar), type of observation data assimilation and utilization of the WRF data assimilation (WRFDA) system
  - WRFDA principles, concepts and technique
  - Background of error concept
  - Preparation of observation data (synoptic and weather radar)
  - WRFDA running procedure
- Understand principles, technique, type and utilization of ensemble forecast system
- Able to process ensemble from WRF model output
- Understand principles, technique and utilization of WRF tropical cyclone (WRF TC) system technique
- Able to run simulation on WRF (DA or TC)
- Identify extreme weather parameter from the output of advanced post-processing
- Verify WRF output with observation data

Ocean modelling

- Explain the ocean wave model products for operational forecasting
  - Wave model products: Significant wave height, swell height
  - Hydrodynamics model: Sea temperature, sea salinity, sea current
- Demonstrate ocean wave model applications: Wave model (Wavewatch III), wave model nearshore (SWAN)
  - Installation
  - Configuration and preparation input
  - Simulation
  - Visualization
- Interpret ocean model products from Wavewatch III, SWAN and hydrodynamics model

Climate modelling

- Understand the role of atmosphere, ocean, cryosphere and land surface inside the climate system and their interaction
- Understand the mechanism of how Earth's energy is energizing the climate system and affecting hydrological and carbon cycle

- Understand state of the art of climate modelling, its historical development, the utilization the numerical resolution of the equations and how scientists test the validity of models

Application of NWP products in daily weather forecasts (practical session)

- Recognize BMKG weather forecast operational services
  - Operational weather prediction
  - Operational early warning
  - Operational weather radar and satellite
  - Operational weather information and dissemination
- Recall multi-model analysis used in BMKG
- Recognize BMKG daily weather forecast operation
  - Daily model evaluation
  - Observational data
  - Global and regional weather modelling
- Recognize nowcasting techniques used in BMKG
- Understand impact-based forecast implementation in BMKG

Pre-course content, activities or assessment

For on-campus courses, participants will be asked to prepare a short presentation about the current status of NWP products and models in their operational weather services. BMKG experts will assist the participants with the course implementation in their countries/territories. This assistance could be applied in the form of mentoring and site visits after both online and on-campus courses are completed.

Course format

The online course will have **asynchronous** sessions utilizing the BMKG Learning Management System (https://lms.bmkg.go.id/) for distributing reading materials, quizzes, forum discussions and assignments. The **synchronous** sessions will be conducted once per week, of 3 hours duration, utilizing Zoom video conferencing software.

The on-campus course will be conducted in Regional Training Centre facilities in Citeko, West Java; at STMKG, Tangerang, Java; and BMKG headquarters in Jakarta.

A further 2 weeks will be allotted for the project assignments in BMKG headquarters in Jakarta. BMKG Learning Management System will be available also for distributing reading materials.

The major learning activities will include, but are not limited to:

- Lectures
- Discussions
- Case studies
- Collaborative decision-making
- Exercises
- Project report and action plan

Learning assessment and evaluation

For the online course, participants will need to complete a pre-test, a post-test and some quizzes and/or assignments during the course to assess their learning progress.

Participants are expected to be active in forum discussions as well as other learning activities.

Initial assessment during on-campus courses will be done through each participant's country/territory report presentation to assess the National Meteorological and Hydrological Service's (NMHS's) capacity in NWP operation. For formative evaluation, case studies and discussions will be used during classroom sessions and some quizzes will be delivered in online sessions. At the end of the course, participants will be asked to write a project report and action plan about how they will implement the enhancement of NWP modelling in their NMHSs.

Instructors and qualifications

Instructors are experienced meteorologists, lecturers and researchers from BMKG or STMKG who hold a master or doctorate degree.

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Blended Group Training on Numerical Weather Prediction at the Regional Training Centre of the Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG), Indonesia

APPLICATION FORM

Note: Please complete the form in typed capital letters and scan in PDF version and send to BMKG by email as soon as possible.

I. Personal Data

1. Family name: _____

   Given Name: _____

2. Gender: _____

3. Date of Birth: _____

4. Place of Birth: _____

5. Passport Number: _____

6. Nationality: _____

7. Marital Status: _____

8. Health Condition: _____

9. History of infectious disease: ☐ No ☐ Yes

Please specify if yes:_____

_____

_____

10. Special Needs (e.g. dietary requirements, disability facilities, etc) if any: _____

_____

_____

11. Address: _____

Mobile phone: _____

Telephone: _____ Fax: _____

Email address: _____@ _____

12. Permanent Address: _____

13. Contact person in emergency:

Name: _____

Address: _____

Mobile phone: _____

Telephone: _____ Fax: _____

Email address: _____@ _____

Statement of present work

Name of institution

_____

_____

Position held _____

Brief description of duties _____

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14. Previous employment history

Date	Institution	Position and Duties

15. Educational and/or professional qualification

Date	Major and University	Degree/Diploma

16. Training Course and Certification

Date	Title

17. Language Proficiency

Mother Tongue _____

English Proficiency (Please tick):

Reading	(a) excellent	(b) good	(c) fair	(d) poor
Listening	(a) excellent	(b) good	(c) fair	(d) poor
Speaking	(a) excellent	(b) good	(c) fair	(d) poor
Writing	(a) excellent	(b) good	(c) fair	(d) poor

18. State why you wish to attend the course and indicate the practical use of the course to your work in the future

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19. For any further information please contact the Local Organizing Committee at the following address:

Ms Ratih Prasetya
The Agency for Meteorology, Climatology and Geophysics of the Republic of Indonesia (BMKG)
Jl. Kemayoran I No 2, Jakarta Pusat, 10720 Indonesia

Telephone: (6221) 4246321 ext. 1071,
Mobile: +62 896 9810 4529
Fax: +62 21 4244710
Email: apply.rtcbmkg@bmkg.go.id ; ratih.prasetya@bmkg.go.id

II. Personal Statement

I hereby declare that the information given above is true, correct and complete. I shall bear the responsibility for the above information.

I pledge to observe all the Indonesian laws and will respect the local customs and follow the course regulations during my stay in Indonesia for the training course.

Permanent Representative | Participant

_____ _____

Date: _____ Date: _____

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