WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

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

Secrétariat
7 bis, avenue de la Paix – Case postale 2300
CH 1211 Genève 2 – Suisse
Tél.: +41 (0) 22 730 81 11
Fax: +41 (0) 22 730 81 81
wmo@wmo.int – public.wmo.int

Ref.: 00597/2021-L4 MS/ETR

Our ref.: 00597/2021/MS/ETFD 28 January 2021

Annexes: 5 (available in English or in the concerned course language only)

Subject: WMO Education and Training Opportunities (2021)

Action required: For information and appropriate action, as required

Dear Sir/Madam,

In response to Goal 4 of the *WMO Strategic Plan 2020-2023* (WMO-No. 1225) which inter alia addresses the need to “develop and sustain core competencies and expertise”, I am pleased to advise you of education and training opportunities that WMO plans to support during the year 2021. Members interested in nominating suitable candidate(s) are required to review the "Compendium of WMO fellowships and training opportunities (2021)" which can be downloaded from the WMO public website and to follow the instructions carefully.

Even in the challenging times we have all witnessed in 2020, which will likely remain uncertain in 2021, WMO strives to support Members in their capacity development endeavours, in cooperation with education, training and fellowship partners and WMO Regional Training Centres. The learning modes in some host institutions may change from on-campus to blended group training (online phase followed by on-campus phase) or online study, so please be aware of such changes. WMO will facilitate the implementation of the Education and Training programme as usual.

In 2021 and 2022, WMO will organize blended group trainings on Numerical Weather Prediction in different WMO Regions and official languages. In 2021 the training courses will be held in the Regional Training Centres of Algeria, Egypt, India and Indonesia. Members are invited to nominate candidates for tailored courses to build the capacity of service delivery personnel. Detailed course plans and cut-off times for nominations are documented in the annexes.

Group familiarization visit(s) will be organized remotely online in 2021 for newly appointed Permanent Representatives (PRs) and National Meteorological and Hydrological Services (NHMS) senior managers who are interested in this programme are encouraged to apply. Meeting dates and schedules will be communicated in due course.

Before the submission of nominations, you are invited to carefully read the Guide on nominations for fellowships and training, attached in the annexes as well as the Criteria on Award of Fellowship and Training Sponsorships found on the WMO public website. Furthermore, please note that for guidance on the choice of institutions for your candidate(s), you are advised to consult the partners listed in the Compendium and WMO Regional Training Centres (RTCs) website, which respectively contain information on fellowships and training opportunities available from institutions and countries that have entered into a special agreement with WMO.

To: Permanent Representatives of Members with WMO

cc: Hydrological Advisers

Unless otherwise stated in the Compendium, any candidate applying for a fellowship to undergo studies in any institution is required to first secure an acceptance letter from that institution, or be in the process of obtaining one, prior to submitting their nomination to WMO.

Due to WMO budgetary constraints, especially in this difficult time, I would encourage you to be selective in the number of candidates you propose. You may therefore consider paying particular attention to how your request aligns with your NMHS needs in human resource capacity building, taking into account gender equity issues. WMO fellowship and training opportunities are desirable to support nominations from developing and Least Developed Countries (LDCs), and Small Island Developing States (SIDS).

Please note that the cut-off date for submission of general nominations to WMO is **31 March 2021** unless stated otherwise in the information table. However, the Secretariat could circulate other available education and training opportunities and welcomes ad hoc requests, to be treated in line with the stipulated criteria. Given the unclear evolution of events relating to the COVID-19 pandemic, WMO can only advise you at the appropriate time on the mode of delivery of the training activities based on what the institutions are able to do as well as the situation with international travel.

I am also taking this opportunity to request that you make us aware of available fellowships and training opportunities that arise within your national institutions that could be available for implementation in collaboration with WMO. Any interest to develop mutually beneficial partnerships could be communicated to the Director, Education and Training Office, who will in turn initiate further negotiations on behalf of WMO. This proposed collaboration could be initiated anytime during the year. Such information could also be availed to other Members through the “WMO Community Platform” and the WMO Global Campus Calendar of events.

I would like to express my appreciation for your continued support to the WMO activities.

Yours faithfully,

Prof. Petteri Taalas
Secretary-General

Guide on nominations for fellowships and training

2021 Compendium of WMO Fellowships and Training Opportunities Requirements and Guide for Application

(https://public.wmo.int/en/programmes/education-and-training-programme)

1. Read through the WMO EC Criteria on Award of Fellowships and Training Sponsorships on ETR website.

2. Check for available fellowship and training opportunities in Compendium and RTCs website.

3. For fellowship nomination, a completed Fellowships Nomination Form (FNF) is required (FNF can be downloaded from ETR website).

4. The FNF must be signed by the Permanent Representative or a formally delegated alternative signatory and sent to the Secretary-General of WMO by the closing dates stipulated for that opportunity.

5. Any nomination must provide an admission letter from the institution for the requested course. The admission letter or accompanying documentation should provide the start and end dates of the course and the costs involved. To obtain the admission letter, candidates must apply to the institution who checks the academic, language and other requirements for that institution.

6. The applicant must be proficient in the language of study and/or provide the documentation regarding their language proficiency as required by the institution. Please note some institutions require an English language test, such as IELTS or TOEFL which may take time to obtain.

7. If multiple candidates are nominated, the Permanent Representative must also provide a priority listing for the candidates.

8. The nominating Member should pay attention to the eligibility quality of the candidates to avoid future withdrawn, drop out, failure and extension of study.

9. Any fellowship award requires all due and overdue post-fellowship reports from previous fellows (completion report and 24-month post fellowship report, PR familiarization reports) to be provided to WMO.

10. Deadlines for nominations must be followed. Late nominations beyond the deadlines are normally not considered. The issuance of the admission letter from institutions and obtaining the result of a required language test takes time. If such a request is foreseen, candidates are suggested to take actions as early as possible.

11. For courses offered by WMO RTCs of less than one month, candidates must use the nomination forms provided by the RTC. A signed request by the PR of the WMO Member is required for WMO support. Participants who have been selected for WMO support will be asked to complete a Request for Financial Assistance (RFA) form.

WMO Fellowship Partners

1.1	China	China Scholarship Council
1.2	China	Nanjing University of Information, Science and Technology (NUIST)
1.3	China	Hohai University
2	France	Ecole Nationale de la Météorologie (ENM)
3	Germany	Leibniz Universität Hannover (LUH)
4	Japan	Disaster Prevention Research Institute (DPRI), Kyoto University
5	Republic of Korea	Ewha Womans University (EWU)
6	Netherlands	IHE-Delft, Institute for Water Education
7	Russian Federation	Russian State Hydrometeorological University (RSHU)
8.1	United Kingdom	University of Reading
8.2	United Kingdom	European Centre for Medium Range Weather Forecast (ECMWF)
8.3	United Kingdom	Scientific Committee on Antarctic Research (SCAR) coming soon
9	United States of America	National Oceanic and Atmospheric Administration (NOAA)
10	Italy	The World Academy of Sciences (TWAS)
11	Argentina	Universidad Nacional del Litoral (UNL)

1.1 China Scholarship Council, China

1	**Host Country**	**China**
2	Host institution(s)	1. Nanjing University of Information Science and Technology (NUIST) 2. Hohai University (Hohai)
3	Website	http://www.campuschina.org
4	Location of Institution(s)	Nanjing, P.R.China
5	Address of Institution	Refer to NUIST and Hohai
7	Course type	BSc, MSc and PhD programme in meteorology and hydrology
8	Faculty/Departments/Majors	Meteorology (NUIST), Hydrology and Water Resources Monitoring & Management (Hohai)
9	Duration of study	BSc: 5 years (including one-year Chinese language study) MSc: 2 to 3 years PhD: 3 years
10	Course start and end date if applicable	September - July every year
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	CSC and WMO full scholarship
13	Basic Requirements	*BSc candidates*: Must be younger than 25 years of age on 1 September (exclusive) of the commencement year of study; *MSc candidates*: Must be younger than 35 years of age on 1 September (exclusive); of the commencement year of study Must hold a BSc degree and IELTS or TOFEL certificate; *PhD candidates*: Must be younger than 40 years of age on 1 September (exclusive) of the commencement year of study and must hold a MSc degree.
14	Language	BSc in Chinese, Chinese Proficiency Test (HSK) Level III Mandatory MSc and PhD can be in English or in Chinese, IELTS 6.0 or TOEFL certificate is recommended if in English
15	Number of awards per year (or per course)	15
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1.WMO FNF 2. Copy of the completed CSC online application form 3. Pre-admission from NUIST or Hohai
19	Applications close date	End of March for Autumn start
20	Contact info	ouzhou@csc.edu.cn NUIST: caiyi@nuist.edu.cn Hohai: 183984639@qq.com

1.2 Nanjing University of Information Science and Technology, China

1	**Host Country**	**China**
2	Host institution(s)	Nanjing University of Information Science & Technology (NUIST)
3	Website	https://gjy.nuist.edu.cn
4	Location of Institution(s)	Nanjing, P.R. China
5	Address of Institution	219 Ningliu Road, Nanjing, Jiangsu Province
7	Course type	MSc and PhD Programs
8	Faculty/Departments/Majors	*MSc programme*: Meteorology, Applied Meteorology *PhD programme*: varies of meteorological related subjects, please refer to the website
9	Duration of study	*MSc programme*: 2 years *PhD programme*: 3 years
10	Course start and end date if applicable	September – July every year
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	NUIST and WMO full scholarship
13	Basic Requirements	Applicants shall have bachelor's degree or master's degree in meteorology or related fields with good academic performance and research ability. *MSc candidates* must be less than 36 years old on 1 September of the year they commence studies. *PhD candidates* must be less than 41 years old on 1 September of the year they commence studies.
14	Language	English, IELTS 6.0 is recommended
15	Number of awards per year (or per course)	10
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. WMO FNF; 2. Pre-admission letter from NUIST
19	Applications close date	End of March for Autumn start
20	Contact info	Tel: 86-25-58699848, Email: caiyi@nuist.edu.cn

1.3 Hohai University, China

1	**Host Country**	**China**
2	Host institution(s)	Hohai University
3	Website	http://ie.hhu.edu.cn/
4	Location of Institution(s)	Nanjing, P.R.China
5	Address of Institution	No.1, Xikang Road, Gulou District, Nanjing, China
7	Course type	MSc or PhD programme
8	Faculty/Departments/Majors	1. Hydrology and Water Resources 2. Agriculture Engineering 3. Water Conservancy and Hydropower Engineering; 4. Harbor, Coastal and Offshore Engineering
9	Duration of study	3 years
10	Course start and end date if applicable	September – July every year
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	Hohai and WMO full fellowship
13	Basic Requirements	*Applicants* shall have bachelor's degree or master's degree in meteorology or related fields with good academic quality and research ability, have a good mastery of English and must be recommended by WMO. *MSc candidates* must be less than 36 years old on 1 September of the year they commence studies. *PhD candidates* must be less than 41 years old on 1 September of the year they commence studies.
14	Language	English, IELTS 6.0 is recommended
15	Number of awards per year (or per course)	20
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. WMO FNF 2. Pre-admission letter from Hohai
19	Applications close date	End of March for Autumn start
20	Contact info	183984639@qq.com

2 WMO-Ecole Nationale de la Météorologie (ENM), Toulouse, France

1	**Host Country**	**France**
2	Host institution(s)	ENM/Météo-France
3	Website	http://www.enm.meteo.fr/
4	Location of Institution(s)	Toulouse, France
5	Address of Institution	42, avenue Gaspard Coriolis BP 45712 31057 TOULOUSE Cedex 1 FRANCE
7	Course type	1. Engineer and Technician courses (BIP-M and BIP-MT) 2. MSc in Meteorology and Climate Sciences 3. Specialized training 4. Vocational training 5. Meteorology and Management
8	Faculty/Departments/Majors	Meteorology and Climate
9	Duration of study	1 week to 3 years
10	Course start and end date if applicable	Variable (check website)
11	Target Region and countries	Least Developed and Developing countries (check website)
12	Fellowship summary	WMO and ENM full/partial fellowship
13	Basic Requirements	Proficiency in course language Variable depending on programmes
14	Language	French
15	Number of awards per year (or per course)	Variable
16	Institution Online application	N/A
17	Admission from Institution	For continuous training and *Météorologie et management* course Mandatory 1. Procedure to apply to be found in the announcement letter on the website; 2. Motivation letter with registration form signed by PR, to be sent to cooperation@meteo.fr; 3. Complete resume; 4. Copy of passport. For initial training, application through Campus France site (http://www.campusfrance.org/fr/user/register)
18	Application forms send to WMO	1. WMO FNF 2. Admission letter from ENM
19	Applications close date	End of March for Autumn start
20	Contact info	cooperation@meteo.fr

3 Leibniz Universität Hannover, Hannover, Germany

1	**Host Country**	**Germany**
2	Host institution(s)	Institute for Hydrology and Water Resources Management, Leibniz Universität Hannover
3	Website	http://www.watenv.de
4	Location of Institution(s)	Hannover, Germany
5	Address of Institution	Appelstrasse 9A 30167 Hannover
7	Course type	MSc programme
8	Faculty/Departments/Majors	Water Resources Management
9	Duration of study	2 years
10	Course start and end date if applicable	1 October – 30 September
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	WMO and LUH full fellowship
13	Basic Requirements	BSc in Water engineering
14	Language	English, CEFR C1 required
15	Number of awards per year (or per course)	Variable
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. WMO FNF 2. Admission letter from University
19	Applications close date	University: January 15th each year WMO: End of March for Autumn start
20	Contact info	starke@iww.uni-hannover.de

4 Kyoto University, Kyoto, Japan

1	**Host Country**	**Japan**
2	Host institution(s)	Disaster Prevention Research Institute (DPRI) Kyoto University
3	Website	http://www.dpri.kyoto-u.ac.jp/en/
4	Location of Institution(s)	Uji, Kyoto
5	Address of Institution	Gokasho, Uji, Kyoto 611-0011 Japan
7	Course type	Certificate
8	Faculty/Departments/Majors	Resilient Societies to Cope with Extreme Weather and Water-Related Disasters
9	Duration of study	3-6 months
10	Course start and end date if applicable	Around October - January
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	DPRI Full scholarship
13	Basic Requirements	Learning and job experiences in meteorology and/or hydrology
14	Language	English
15	Number of awards per year (or per course)	up to 3
16	Institution Online application	Optional
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. WMO FNF 2. Admission letter from DPRI
19	Applications close date	End of March for Autumn start
20	Contact info	takara.kaoru.7v@kyoto-u.ac.jp

5 Ewha Womans University, Seoul, Republic of Korea

1	**Host Country**	**Republic of Korea**
2	Host institution(s)	Department of Climate and Energy Systems Engineering, Ewha Woman University
3	Website	http://cese.ewha.ac.kr
4	Location of Institution(s)	Seoul, Korea
5	Address of Institution	52, Ewhayeodae-gil, Seodaemun-gu Seoul 03760 Republic of Korea
7	Course type	Master of Engineering, Master of Science
8	Faculty/Departments/Majors	1. Numerical Weather Prediction 2. Dynamic Meteorology 3. Climate Physics 4. Synoptic Meteorology 5. Satellite Meteorology 6. Remote Sensing
9	Duration of study	2 years (4 semesters/per course)
10	Course start and end date if applicable	March - February
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	WMO and EWU EGPP/F2 full fellowship
13	Basic Requirements	Female candidate only. Master's: Applicant must have completed a four-year-course university or university-equivalent courses and acquired bachelor's degree.
14	Language	English/Korean: Applicant must meet language requirements stated on the website: TOEFL (PBT550, iBT80), IELTS5.5, TEPS 550
15	Number of awards per year (or per course)	2
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. FNF 2. Admission letter from EWU
19	Applications close date	EWU: EWU's online application opens around September (http://isa.ewha.ac.kr) WMO: 30 November each year for Spring start
20	Contact info	Office of international student affair isadmit@ewha.ac.kr

IHE Delft, Institute for Water Education, Delft, Netherlands

1	**Host Country**	**Netherlands**
2	Host institution(s)	IHE Delft, Institute for Water Education
3	Website	https://www.un-ihe.org/ https://www.studyinholland.nl/finances/orange-knowledge-programme
4	Location of Institution(s)	Delft
5	Address of Institution	P.O.Box 3015 2601 DA, Delft Netherlands
7	Course type	MSc programme
8	Faculty/Departments/Majors	1. Hydrology and Water Resources 2. Hydraulic Engineering and River Basin Development 3. Land and Water Development for Food Security 4. Hydroinformatics - Modelling and Information Systems for Water Management 5. Coastal Engineering and Port Development 6. Water Management and Governance
9	Duration of study	18.5 months
10	Course start and end date if applicable	3rd week October – last week April
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	WMO and IHE full fellowship
13	Basic Requirements	BSc degree
14	Language	English: https://www.un-ihe.org/english-language-requirements
15	Number of awards per year (or per course)	1
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory
18	Application forms send to WMO	1. WMO FNF 2. Admission letter from IHE 3. Orange Knowledge Programme scholarship admission letter
19	Applications close date	End of March each year for Autumn start
20	Contact info	i.melis@un-ihe.org m.baburek@un-ihe.org

7 Russian State Hydrometeorological University, St. Petersburg, Russian Federation

1	**Host Country**	**Russian Federation**
2	Host institution(s)	Russian State Hydrometeorological University (RSHU)
3	Website	http://www.rshu.ru/ http://www.rshu.ru/eng/ http://ums.rshu.ru/ http://apply.rshu.ru/content/eng/howtoapply/fellowship/
4	Location of Institution(s)	St. Petersburg, Russia
5	Address of RTC	79, Voronezhskaya str. St. Petersburg Russia 192007
7	Course type	BSc, MSc and PhD programmes
8	Faculty/Departments/ Majors	Meteorology, Hydrology, Ecology and Environmental Physics, Oceanography.
9	Duration of study	BSc: 4+1 years MSc: 2+1 years PhD: 3+1 years (1 year in Russian language if needed)
10	Target Region and countries	Least Developed and Developing countries
11	Fellowship summary	WMO and RSHU full fellowship
12	Basic Requirements	*BSc candidates*: Must be younger than 30 years of age on 1 September of the commencement year of study (exclusive) *MSc candidates*: Must be younger than 35 years of age on 1 September of the commencement year of study (exclusive); Must hold a BSc degree *PhD candidates*: Must be younger than 60 years of age on 1 September of the commencement year of study (exclusive); Must hold a MSc degree.
13	Language	Russian
14	Number of awards per year	20
15	Institution Online application	Mandatory: http://russia.study/ All RSHU candidates should obtain the Quota Scholarship of the Russian Government which covers tuition fee.
16	Admission from Institution	Mandatory. Please refer to the foot notes.
17	Application forms send to WMO	1. WMO FNF 2. Confirmation from RSHU that candidate participates at the procedure of Quota Scholarship of the Russian Federation Government 3. Copies of all supporting documents
18	Applications close date	End of March for Autumn start
19	Contact info	Please contact wmo.mobility@rshu.ru, ums@rshu.ru for the documents required.

7 RSHU application step by step guide for WMO fellowships (2018 enrolment)

1. All RSHU candidates should obtain the Quota Scholarship of the Russian Government. Candidate should provide to WMO the confirmation letter from RSHU that he/she participates at the Quota Scholarship selection procedure.
2. To obtain the Quota Scholarship candidate must apply to the Russian Consulate/Embassy or to the Russian Centre for Science and Culture (http://rs.gov.ru/en/contacts) in their respected country. Please remember that admission deadline for the Quota Scholarship is different in each country, don't forget to check the website.
3. Please contact RSHU for the further information in advance.

Процедура подачи заявки на стипендию ВМО для обучения в РГГМУ:

1. Все кандидаты РГГМУ должны получить квоту Правительства Российской Федерации. Кандидат должен предоставить в ВМО письмо-подтверждение от РГГМУ об участии в конкурсе на квоту Правительства РФ.
2. Чтобы получить квоту Правительства РФ, кандидат должен обратиться в Посольство России или Российский центр науки и культуры (http://rs.gov.ru/ru/contacts) в своей стране. Важно: сроки подачи заявки на квоту Правительства РФ в каждой стране различны, не забывайте проверять сайт! Обычно прием заявок начинается в декабре.
3. Свяжитесь с РГГМУ для получения более подробной информации.

Contact:
International Relations Office,
Russian State Hydrometeorological University,
Saint-Petersburg, Russia
wmo.mobility@rshu.ru
ums@rshu.ru
Tel: 8 (812) 633 01 96

8.1 University of Reading, Reading, United Kingdom

1	**Host Country**	**The United Kingdom of Great Britain and Northern Ireland (UK)**
2	Host institution(s)	University of Reading
3	Website	http://www.met.reading.ac.uk/pg-taught
4	Location of Institution(s)	Reading
5	Address of Institution	Whiteknights Reading, RG6 6BB
7	Course type	MSc in Applied Meteorology and Climate with Management*
8	Faculty/Departments/Majors	Department of Meteorology
9	Duration of study	12 months
10	Course start and end date if applicable	September – September each year
11	Target Region and countries	Developing countries
12	Fellowship summary	WMO and UK Met Office full fellowship
13	Basic Requirements	Second-class honours degree in a physical, environmental or engineering science, and A-level (or equivalent) mathematics and/or physics. Candidates with different or slightly lower qualifications, or who have significant professional experience may be considered. Please contact: met-infosec@lists.reading.ac.uk to enquire.
14	Language	English**
15	Number of awards per year	Up to 5
16	Institution Online application	Mandatory
17	Admission from Institution	Mandatory***
18	Application forms send to WMO	1. WMO FNF 2. Letter of Offer from University of Reading 3. UK Application Form (Attached)
19	Applications close date	End of March each year for Autumn start
20	Contact info	met-mscinfo@lists.rdg.ac.uk

* Fellowship funding is only available for the MSc in Applied Meteorology and Climate with Management. Other MSc courses are not funded under this programme.

** IELTS: 6.5 overall with no element less than 5.5 (or equivalent) is required.

*** Application to University of Reading should be made as early as possible and **no later than 28 February in 2020.** The University can issue a conditional offer letter to send to WMO prior to the applicant passing the IELTS test, but the required Letter of Unconditional offer will not be issued until the language condition has been met. If you have any queries about this, please contact met-mscinfo@lists.rdg.ac.uk

UK APPLICATION FORM

(ADDITIONAL INFORMATION)

MSc in "Applied Meteorology and Climate with Management"

Ref.: 00599/2021-LL MS/ETR

Name of Applicant	
Current Employer	

Statement of your suitability for the proposed fellowship:

Please could you a provide a statement below, explaining why you are a suitable candidate for this fellowship, including:

- Your main motivation for applying for this course
- Your professional plans for the future and how you would like to develop your career within your organisation
- How you think you will be able to contribute to the future plans and strategic development of your organisation, as a result of skills gained from this fellowship

(Please continue onto another page, if required)

Signature of applicant:

Date:

8.2 European Centre for Medium Range Weather Forecast, Reading, UK

1	**Host Country**	**The United Kingdom of Great Britain and Northern Ireland (UK)**
2	Host institution(s)	European Centre for Medium Range Weather Forecast (ECMWF)
3	Website	http://www.ecmwf.int
4	Location of Institution(s)	Reading, UK
5	Address of Institution	Shinfield Park
7	Course type	N/A
8	Faculty/Departments/Majors	N/A
9	Duration of temporary secondment	up to 12 months
10	Secondment start and end date if applicable	Variable
11	Target Region and countries	Least Developed and Developing countries
12	Fellowship summary	The temporary attachment of the expert will work with designated experts at ECMWF to enhance skills as appropriate in areas such as global weather prediction in the medium range, extended-range forecast for up to a year ahead, use of advanced computer modelling techniques to analyse observations and predict future weather.
13	Basic Requirements	Qualifications will depend on the focus of the available opportunities for placement at ECMWF.
14	Language	English
15	Number of awards per year	1
16	Institution Online application	Information and submission: https://www.ecmwf.int/en/learning/training/wmo-fellowship-scheme
17	Application forms send to WMO	WMO FNF
18	Applications close date	End of March each year
19	Contact info	anna.ghelli@ecmwf.int

9 NOAA, Washington DC, USA

1	**Host Country**	**United States of America**
2	Host institution(s)	NOAA/National Weather Service
3	Website	http://www.wpc.ncep.noaa.gov/international/intl2.shtml
4	Location of Institution(s)	Washington DC
5	Address of Institution	College Park, Maryland
7	Course type	Training Certificate and/or Competencies Certificate
8	Faculty/Departments/Majors	NCEP International Desks
9	Duration of study	4 months
10	Course start and end date if applicable	Variable
11	Target Region and countries	WMO Region I (Africa), Region III and IV (Northern South America)
12	Fellowship summary	Training emphasizes the understanding of atmospheric dynamics and the application of numerical model guidance for the generation of quantitative precipitation forecast products, sub-seasonal and climate forecasts. It applies WMO competencies standards for general forecaster.
13	Basic Requirements	Open to all meteorologists and technicians (forecasters), with priority given to meteorologists.
14	Language	English, Spanish for RA-III
15	Number of awards per year	Opportunity is not available for 2021 new applicants
16	Institution Online application	N/A
17	Admission from Institution	Mandatory
18	Application forms send to WMO	WMO FNF
19	Applications close date	Training slots will be assigned a year in advance, with nomination package on file no later than four months prior to the beginning of the fellowship.
20	Contact info	ethan.jessup@noaa.gov African Desk: wassila.thiaw@noaa.gov South America/Tropical Desks: michel.davison@noaa.gov

1	**Host Countries**	**7 emerging countries: Brazil, China, India, Malaysia, Pakistan, South Africa and Thailand**
2	Host institution(s)	TWAS has about 1000 eligible host institutions in 6 developing countries with 11 programme partners
3	Website	http://twas.org/opportunities/fellowships/phd
4	Location of Institution(s)	Developing countries
5	Address of Institution	Refer to http://twas.org/
6	Course type	PhD in Natural Sciences
7	Faculty/Departments/Majors	Meteorology, hydrology and environmental science related
8	Duration of study	PhD: 3-5 years
9	Course start and end date if applicable	Various among partners
10	Target Region and countries	Least Developed and Developing countries
11	Fellowship summary	Full coverage of full PhD costs
12	Basic Requirements	MSc degree, preliminary admission letter from eligible host institution according to chosen host country and programme partner
13	Language	English, Portuguese
14	Number of awards per year (or per course)	10 PhD fellowships for WMO
15	Institution Online application	N/A
16	Admission from Institution	Mandatory: Must have preliminary admission letter from eligible host institution BEFORE applying, must comply with all eligibility criteria of the selected programme e.g. age limit etc.
17	Application forms to be sent to WMO	1. WMO FNF 2. TWAS partner preliminary admission letter
18	Application forms to be sent to TWAS	Online portal for application
19	Applications close date	TWAS: Ranges between 31 August to 15 September each year, but some deadlines change yearly. WMO: End of September each year
20	Contact info	fellowships@twas.org

11 Universidad Nacional del Litoral, Santa Fe, Argentina

1	Host Country	Argentina
2	Host institution(s)	Faculty of Engineering and Water Sciences, Universidad Nacional del Litoral
3	Website	http://fich.unl.edu.ar
4	Location of Institution(s)	Santa Fe, Argentina
5	Address of Institution	Ciudad Universitaria Ruta Nacional N° 168 - Km 472,4. (3000) Santa Fe Argentina
7	Course type	1. Mater's in Water Resources Engineering 2. Master's in Integrated Water Resources Management
8	Faculty/Departments/Majors	Faculty of Engineering and Water Sciences, Universidad Nacional del Litoral (FICH-UNL)
9	Duration of study	2 (two) years
10	Course start and end date if applicable	March – December next year
11	Target Region and countries	WMO RAIII and Latin-American countries
12	Fellowship summary	WMO and University full fellowship
13	Basic Requirements	Applicants must have a pre-graduate degree (Engineer, Bachelor or similar) in related disciplines granted by Argentine or foreign universities recognized by competent authorities.
14	Language	Spanish
15	Number of awards per year (or per course)	2
16	Institution Online application	N/A
17	Admission from Institution	Mandatory
18	Application forms send to WMO	a. Fellowship Nomination Form WMO b. Admission letter (FICH-UNL)
19	Applications close date	15th December for March start next year
20	Contact info	Dra. Marcela Perez E-mail: maperez@fich.unl.edu.ar; perezmarcelaa@gmail.com

WMO Group Training Opportunities on Numerical Weather Prediction

Region	Host Members	Host institutions
I	Algeria	WMO Regional Training Centre Hydrometeorological Institute for Training and Research (IHFR)
II	Egypt	WMO Regional Training Centre
III	India	WMO Regional Training Centre Meteorological Training Institute
IV	Indonesia	WMO Regional Training Centre State College of Meteorology, Climatology and Geophysics

1 Institut hydrométéorologique de formation et de recherche, Algérie

1	**Membre hôte**	**Algérie**
2	Institution (s) d'accueil	Institut hydrométéorologique de formation et de recherche (IHFR)
3	Site Internet	ihfr.edu.dz/learning
4	Emplacement (ville) de l'établissement	Oran
5	Adresse de l'Institut	Boîte postale 7019 Hai ESSeddikia 31025 Oran Algérie
7	Type de cours	De préférence combiné en ligne et sur le campus (mixte) ou cours en ligne
8	Contenu du cours	Le cours sera scindé en deux parties à savoir : Une partie théorique dans laquelle les notions de bases nécessaires à la compréhension de différents schémas d'intégration numérique et de paramétrisation physique seront traités. Tandis que la seconde sera dédiée à la mise en marche du modèle WRF (modèle open source) et la réalisation de plusieurs simulations numériques, permettant une bonne familiarisation avec les différents codes utilisés dans les modèles numériques ainsi que les techniques de la paramétrisation physique. Pour plus de détail prière de consulter le programme de formation.
9	Durée des études	Deux mois + un mois
10	Date de début du cours	du 05 avril au 28 mai 2021 du 05 au 30 septembre 2021
11	Région cible et membres	Association régionale de l'OMM I Membres en développement
12	Exigences de base	Les météorologues ayant exercé au moins deux années dans le domaine de la prévision numérique de temps et titulaire d'un diplôme de Météorologiste (OMM).
13	Langue	Français
14	Nombre de stagiaires	En ligne 30 Sur le campus 15
15	Application en ligne de l'institution	Optionnelle
16	Admission de l'établissement	Obligatoire
17	Formulaires de demande envoyés à l'OMM	1. OMM FNF 2. Lettre de préadmission de l'établissement d'accueil
18	Date de clôture des candidatures	12 Février 2021
19	Contact info	ihfr@ihfr.edu.dz mtabetaoul@yahoo.fr

2 WMO Regional Training Centre, Egypt

1	**Host Member**	**Egypt**
2	Host institution(s)	WMO Regional Training Centre Egyptian Meteorological Authority (EMA)
3	Website	nwp.gov.eg (temporary out of service for upgrade)
4	Location(city) of Institution(s)	Cairo
5	Address of Institution	Koubri El-Ouobba, PO Box 11784, Cairo, Egypt
7	Course type	Online course
8	Main course content	*Introduction (Week 1)* • Historical overview of NWP Cycle • Atmospheric Observing Systems and the continuum Atmosphere • Errors in Meteorological Observation • Quality Control of Data and Objective Analysis *NWP Basics (Week 2-3)* • Introduction to NWP • An overview of Global, regional, and local models • Review of the dynamical meteorology • Human added- value to numerical weather prediction • Visualization weather model outputs and evaluation. • Review of some statistics • Introduction of verification *Practices (Week 4-7)* • Data formats e.g. NetCDF, grib, ascii, etc.) • A display system of the model output (Grads, NCL, IDV, Panoply to visualize Data • Use of derived fields (CAPE, etc.) • Using satellite data as background to NWP variables • Detecting errors in the model output • Forecast verification and validation • Using statistical package e.g. CDO, NCL etc for interpretation, and verification of the model outputs • Test cases of extreme weather • Utilizing free internet resources e.g. www.windy.com *Final Exam & Project. (Week 8)*
9	Duration of study	Two months
10	Course start date	To be decided (TBD) in 2021
11	Target Region and Members	WMO RA I and II Arabic speaking Developing Members
12	Basic Requirements	Meteorologist with BSc degree or equivalent, 2-year working experiences.
13	Language	English and Arabic
14	Number of awards	30
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	To Be Decided
19	Contact info	Mr Mohamed Tawfik: mohamedtawfik99@hotmail.com

3 Meteorological Training Institute, India

1	**Host Member**	India
2	Host institution(s)	Government of India, Ministry of Earth Sciences, India Meteorological Department, Meteorological Training Institute WMO RTC Pune component in India
3	Website	http://www.imdpune.gov.in/training/training.html
4	Location(city) of Institution(s)	Pashan, Pune
5	Address of Institution	Meteorological Training Centre (MTI), IMD Colony Campus. Dr.Homi Bhaba Road, Pashan, Pune, Pin 411008, Maharashtra State India
7	Course type	Online and follow-up on-campus course
8	Main course content	• History & Hierarchy of NWP • Numerical Methods • Spectral method • Data assimilation • Physical Parameterization • Operational forecast models • Interpretation & application of NWP output • Practical exercise
9	Duration of study	Two months (8 weeks) Follow-up on-campus course: 2 weeks
10	Course start date	5th April 2021
11	Target Region and Members	WMO Regional Association II Developing Members
12	Basic Requirements	Meteorologist with BSc degree or equivalent, with 2-year working experiences.
13	Language	English
14	Number of awards	30 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	12 February 2021
19	Contact info	Dr. Somenath Dutta Head, Meteorological Training Centre (MTI), India Meteorological Department, Pashan, Pune-411008, India Email: dutta.drsomenath@gmail.com & Shri.R.K.Giri Head, Organization. India Meteorological Department Mausam Bhavan, Lodi Road. New Delhi-110003 Email: rk.giriccs@gmail.com

4 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	Two months Possible follow up on campus course
10	Course start date	To be decided (TBD)
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	To Be Decided
19	Contact info	Ms. Ratih Prasetya Email: apply.rtcbmkg@bmkg.go.id; ratih.prasetya@bmkg.go.id

Formation conjointe du groupe IHFR-OMM

En

Prévision Numérique du Temps

Dispensé par

L'Institut Hydrométéorologie de Formation et de Recherches

Au cours des deux (2) Périodes

- du 05 avril au 28 mai 2021
- du 05 au 30 septembre 2021

1- Description du cours

Prévoir des phénomènes météorologiques avec une précision dépendant essentiellement de la prévision météorologique avec toutes ses composantes, à partir de l'ass imilation des données, paramétrisation, intégration numérique, post-traitement, etc.

Par conséquent, le personnel météorologique chargé des prévisions météorologiques devrait avoir des connaissances et compétences raisonnables sur différents aspects de la PNT. Ils doivent être suffisamment capables pour comprendre, interpréter et appliquer les différents produits de PNT de manière parfaite avec une grande maitrise. Ils doivent être en mesure d'apprécier la teneur scientifique du changement de précision dans un PNT prévisions, en raison de certains ajustements du modèle PNT. Ceux-ci ne peuvent être atteints que par concevoir, diriger et participer à la formation en PNT. En tenant compte de tout ce qui précède, cette formation a été conçue pour le personnel de prévision. Des efforts ont été faits pour bien exploiter les potentiels du modèle WRF (Weather Research and Forecasting).

Le personnel destiné à assurer ce cours doit maitriser d'une manière parfaite toutes les étapes de la PNT, en l'occurrence : la compréhension, l'application des différents produits et de quantifier et apprécier la teneur scientifique des différents changements qui en découlent.

*2- **Objectifs d'apprentissage***

Cette formation requiert des connaissances de certains modules introductifs, tels que : modules de base de la prévision numérique du temps . De même, des travaux pratiques et des exposés, seront prévus lors des ateliers, ceci dans le but :

- Mise à jour des connaissances relatives aux phénomènes météorologiques et les processus associés
- Connaitre les différentes techniques et procédures utilisées pour réaliser une prévision.
- Savoir et savoir faire les taches principales de la PNT de courte, moyenne et, longue échéances.
- Maitriser la modélisation et la paramétrisation de l'atmosphère ainsi que les méthodes d'assimilation des données.
- Maitriser les outils de la prévision, et les principes et méthodes de mise en œuvre des modèles numériques.
- Mise en œuvre et l'exécution du modèle opérationnel WRF (Weather Research Forecast) et la réalisation des prévisions réelles.
- Exploiter la puissance du modèle numérique par l'étude de plusieurs situations et phénomènes météorologiques.
- Comprendre le problème de l'état initial et les conditions aux limites, ainsi que toutes les difficultés des prévisions météorologiques.
- Comprendre le taux d'incertitude d'une prévision numérique ainsi les techniques de la prévision d'ensemble.
- Comprendre, interpréter et appliquer de manière appropriée différents produits de la prévision numérique du temps.
- Définir plusieurs types de situations où un modèle à haute résolution pourra fournir des indications utiles qui ne sont pas évoquées par des modèles de résolution plus faible et de préciser les types de renseignements.
- Déduire la résolution nécessaire pour obtenir un modèle parfait capable de prévoir un phénomène particulier ;
- Mettre en évidence les avantages et les limites extrêmes de la prévisibilité que fournit le modèle WRF

*3- **Public cible et qualifications***

Ce stage s'adresse aux météorologistes des pays de la région RA-I, qui ont suivi avec succès leur formation de niveau Class I, Class II, ou titulaires d'un Master scientifiques (mathématiques, physique, informatique, …), et qui ont exercé dans le domaine de la prévision numérique.

*4- **Course Content***

Cette formation est articulée sur les axes suivants :

- Des conférences animées par des spécialistes de la prévision numérique.
- Présentation des thèmes et application incluant des exercices, sous forme d'activité en ligne (TEAMS) ou hors ligne (MOODLE)
- Chaque participant fera un exposé scientifique du domaine de la PNT.
- La phase pratique est constituée des travaux pratiques sur PC, suivie par des ateliers animés avec la collaboration d'autres services (CDER, ONM/PNT)
- Les stagiaires seront contrôlés régulièrement à la fin de chaque thème /atelier sous forme d'un test QCM/exposé.
- En phase finale : les participants subiront une évaluation finale et que sera sanctionnée par une attestation de stage ou certificat.

5- Dernière date de réception des nominations : 12/02/2021

Ref.: 00595/2021-L1 MS/ETR

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L'Institut Hydrométéorologie de Formation et de Recherches

Au cours des deux (2) Périodes

- du 05 avril au 28 mai 2021
- du 05 au 30 septembre 2021

Programme de la formation

	La phase théorique	La phase pratique
Type de formation	En ligne (TEAMS) Hors ligne (MOODLE)	En présentiel Sur PC
Volume horaire	120 heures	120 heures
Nombre de semaines	Huit (8) semaines	Quatre (4) semaines
Date de début de formation	05 Avril 2021	05 Septembre 2021
Date de Fin de formation	28 Mai 2021	30 septembre 2021
Nombre d'heures/jours	Trois (3) heures	Six (6) heures
heures de formation	De 08h45 à 12h00 CET	De 08h45 à 12h00 CET De 13h00 à 16h45
Weekend	Samedi/Dimanche	Vendredi/Samedi
Nombre d'étudiants	30 étudiants	15 étudiants

WORLD METEOROLOGICAL ORGANIZATION

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Au cours de la Période

- du 05 avril au 28 mai 2021

Contenue des cours (phase théorique)

Nr	thème	module	contenue	vol
1	Introduction	Historique	Historique de la PNT	3
		motivation	Les principes et méthodes de mise en œuvre des modèles numériques	
		Composante de bases	Echelles et les interactions atmosphériques	
		difficultés	Techniques d'estimation de l'incertitude des prévisions,	
			Equation primitives	
			Variables : pronostiques et diagnostiques	
2	Calcul numériques	Maths	Développements limités	3
			Equations aux dérivées partiales	
			Transformations de Fourier	
			Polynôme de Legendre	
		Statistiques	Statistique de base (RMSE, corrélation régression)	1
		Analyse numérique	Dérivations numériques	2
			Résoudre des équations Non linéaire	
			Intégration numérique	
			Résoudre d'un système d'équation (GAUSS)	
		Numérisation	Différences fines	9
			Méthode spectrale : transformation de Fourier	
			Harmoniques sphériques : transformations de Legendre	
			Schémas d 'intégrations et l'étude de stabilité	
		contrôle 1	***QCM (Quizz Ispring)***	***30 mn***

3	Dynamique de	Mécanique de fluides	Fluides géophysiques	2
			Cinématique des fluides	
		Dynamique des latitudes moyennes	le système de Navier stocks	6
			Tourbillon et le tourbillon potentiel	
			Ondes atmosphériques	
		Dynamique tropicale	Spécificités de la région tropicale	
			Climatologie de la région tropicale	
			Perturbations tropicales	
			Cyclogenèse des tempêtes tropicales	
		Modélisation	Techniques de modélisation	11
			Grilles d 'Arakawa	
			Projections conformes	
			La chaine de prévision	
			Les modèles : hydrostatiques et Non-hydrostatique	
			Les modèles ; globaux et LAM	
			Problèmes de conditions initiales et aux limites	
			La prévisibilité	
		contrôle 2	***QCM (Quizz Ispring)***	***30 mn***
4	Physique de	Rayonnements	Transfer et bilan radiatif	2
			Rayonnements solaires et telluriques	
			Rayonnements : longwave et shortwave	
		Convection	Approche à l'échelle synoptique	3
			Approche à l'échelle Aérologique	
			Des nuages aux précipitations	
		phénomènes à petite échelles	Microphysique des nuages	3
			Turbulence des basses couches	
			Phénomènes locaux	
		Paramétrisation	Généralité de la physique du modèle	15
			Processus physique de l'atmosphère et à la surface	
			Principe et technique de la paramétrisation	
			Schémas de microphysique	
			Schémas de rayonnement longwave et shortwave	
			Schémas de nuages	
			Schémas de processus de la surface	
			Schémas de la convection	
			Schémas de couche de la surface et plantaire	
			Schémas de la diffusion	
			Schémas de la dispersion et transport des aérosols	
		contrôle 3	***QCM (Quizz Ispring)***	***30 mn***
5	L'assimilation des données	Les données Météorologiques	Le système mondial d'observation	9
			Les données d'observation (Synop, SHIP, SPEMT..)	
			Les données satellitaires (SEVERI, HIRS, AISI, SATOP ….)	
			Les données d'aéronautiques (AMDAR, SIGMET TAF, TAFFOR…...)	

			Les données maritimes (TRACKOB, WAVEOB BUOY….)	
			Les données RADAR	
		Base de données	Transfer de données	6
			Codage et décodage de données	
			Base des données ODB	
			Filtrage (digital, normaux)	
		La chaine d'assimilation	Analyse objective	9
			Méthodes de cressman	
			Interpolation optimale	
			Assimilation variationelle 3DVAR	
			Assimilation variationelle 4DVAR	
6	La prévision opérationnelle	Post-traitement de sorties	Produit de la PNT	12
			Analyse des sorties (cartes, graphes)	
			Produits satellitaires	
			Imageries radar	
			Diagramme thermodynamique	
		Contrôle et adaptation	Le contrôle subjectif	6
			Le contrôle objectif	
			L'adaptation	
		Prévision d'ensemble	Effet chaotique et principe de PE	3
			Les méthodes utilisées	
			Cas réelle : GFS et ECMWF	
		Les prévissions	Prévision marine	6
			Prévision aéronautique	
			Prévision immédiate (Nowcasting)	
			Prévision à moyenne échéance	
			Prévision saisonnière	
			Prévision climatique	
		Environnement du prévisionniste	Les modèles numériques opérationnels	2
			Les puissances humaines	
			Les outils et matérielles	
			Les usagers et clientèles	
		Le modèle WRF	C'est quoi le modèle WRF	3
7	***Evaluation et contrôle***	***contrôle 4***	***QCM (Quizz Ispring)***	***30 mn***
		Examen final	***QCM (Quizz Ispring), + Exposée***	***1***
		note finale	***(moyenne des 4 contrôles + exposée + examen final)/3***	

WORLD METEOROLOGICAL ORGANIZATION

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Formation conjointe du groupe IHFR-OMM

En

Prévision Numérique du Temps

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L'Institut Hydrométéorologie de Formation et de Recherches

Au cours de la Période

- du 05 au 30 septembre 2021

Contenue des cours (phase pratique)

Nr	thème	branche	contenue	volume
1	Informatique	System Linux	Fonctions de base du système linux	3
			Commandes principales	
			Scripting Shell : SH et CSH	
		Programmation Fortran	Instructions de fortran (boucles et condition)	3
			Commande READ et WRITE	
			Procédures, Modules, Includes, Pointeurs	
		Outils de visualisation	Grads	3
			NCL	
			NCview et HDFview	
2	modèle WRF	Généralisées	Présentation de modèle	3
			Mise en œuvre et implémentation	
		Pre-Processing	Données : GFS, WAFS, ECMWF…….	6
			Edition de namelist.wps	
			Domaine, résolution et projection	
			Edition des variables : VTABLE	
			Edition de donnes géographiques : GEOGRID.TBL	
			Edition de donnes météorologiques : METGRIB.TBL	
		Exécution cas Réel	Configuration de WRF-ARW	3
			Etude de cas idéal, cas réel	
			Edition de namelist.input	
			Exécution de real.exe, wrf.exe	

			Modification d'options de la dynamique et de la physique	
		Post- Processing	Fichiers GRIB et NETCDF	6
			Code source UPP	
			Outils ARWPOST et RIP4	
			Choix des niveaux verticaux et les variables météorologiques	
			Visualisation : Grads et NCL	
		Traitement des produits	Amélioration des produits	3
			Diversification de produits	
			Contrôle la qualité des produits	
3	Ateliers	Atelier 1	Paramétrisation de la température et de la SST	6
		Atelier 2	Paramétrisation de la convection et physique de nuages	6
		Atelier 3	Sensibilité de la prévision aux variables internes et externes	6
		Atelier 4	Dispersion d'aérosols par WRF-Chem	12
		Atelier 5	Contrôle du modèle par l'analyse	6
		Atelier 6	Analyse objectives OBSGRID	12
		Atelier 7	Cyclones tropicaux et trajectoires	6
		Atelier 8	Assimilation des données WRFDA	12
		Atelier 9	Exploitation de WRF aux énergies renouvelables	12
		Atelier 10	Exploitation de WRF en Hydrologie (WRF-HYDRO)	12

WORLD METEOROLOGICAL ORGANIZATION

Ref.: 00596/2021-L1 MS/ETR

Joint IMD-WMO group fellowship Training

On

Numerical Weather Prediction

Through

Distance learning mode

Managed by

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

During

5 April to 28 May 2021

Course Description

Predicting weather phenomenon with reasonable accuracy crucially depends on the Numerical weather prediction with its all components, starting from data assimilation, physical parameterization, numerical integration, post processing, etc. Recent prediction of extreme weather events like Super Cyclone UMPHAN in India with phenomenal accuracy has again proved it. Hence Meteorological personnel engaged in weather forecasting should have reasonable knowledge and skill on different aspects of NWP. They must be capable enough to understand, interpret and apply different NWP products more appropriately with full confidence. They must be able to appreciate the scientific reason for the change in accuracy in a NWP forecast, due to certain tuning in the NWP model. These can only be achieved by systematically designing, conducting and participating training in NWP.

Keeping all above in mind, this training course has been designed for the forecasters and NWP personnel. Efforts have been made to maintain BIP-M standard. By attending this course weather forecasting personnel in the NMHS shall be capable enough to understand, interpret and apply different NWP products more appropriately with full confidence and they will be able to appreciate the scientific reason for the change in accuracy in a NWP forecast, due to certain tuning in the NWP model.

Expected Learning Outcomes

After successfully completion of this program, participants shall be able to:

- understand about an initial & boundary value problem and also understand that the problem in NWP and associated issues in weather forecasting.
- know about the history & hierarchy of NWP models.
- know & understand different numerical methods and spectral method for solving the governing equations, along with their difficulties, like linear & nonlinear instability.
- understand various data assimilation methods.
- understand different schemes for parameterizing important physical processes.
- understand different NWP models along with the basics of developing a NWP model.

- understand the uncertainty in a NWP forecast and how to interpret ensemble prediction.
- understand, interpret and apply different NWP products appropriately to improve forecasting services for severe and hazardous weather.

Target Audience and Qualifications

Forecasters and NWP personnel from countries in RA-II Region who have successfully completed BIP-MT course and having Educational qualification B.Sc. (with Physics, Mathematics as major subjects) with at least 2 years' experience in NWP and/or weather forecasting.

Course Content

- The event shall consist of on line lectures/presentations on certain broad themes, on line some practical exercises. Each participant shall make a review presentation of any research paper of their choice only, on any aspect of NWP. The broad themes, to be discussed are given below: History & Hierarchy of NWP, Numerical Methods, Spectral method, Data assimilation, Physical Parameterization, Operational forecast models, Interpretation & application of NWP output and Practical exercise. At the end of the course trainees shall be examined by a MCQ type test, based on the result of which their participation shall be certified.
- **Course Format**

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

- **Last date of receiving nominations**: 12/02/2021

WORLD METEOROLOGICAL ORGANIZATION

Joint IMD-WMO group fellowship Training

On

Numerical Weather Prediction

Through

Distance learning mode

Managed by

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

During

5 April to 28 May 2021

Ref.: 00596/2021-L1 MS/ETR

Joint IMD-WMO group fellowship Training
On
Numerical Weather Prediction
By
Meteorological Training Institute, India Meteorological Department (IMD), Pune
During
05/04/2021 -28/05/2021
Mode: Distance Learning (Online & Off line)

Course content & resource personnel

Sr. No	Broad Theme	Main topic	Sub topics	Proposed Resource person	Duration (hrs)
1	Introduction	History, Motivation ,broad basic components & Hierarchy	1. Basic concept of an Initial value problem. Hierarchy of NWP model. 2. Limitation in traditional synoptic method, demand for a location and time specific forecast system, giving rise to the concept NWP. 3. Potential of NWP system to give location and time specific forecast. 4. A generic structure of a NWP system. 5. History & Hierarchy of NWP	Dr.S Dutta, IMD,	2
2	Difficulties	Nature of governing equations and difficulties to solve them	1. Discussions on different types of differential equations and to show that governing equations are non-linear partial differential equation. 2. Difficulties in getting analytical or exact solution of such equations. 3. Alternative Approaches-Numerical methods and Spectral method.	Dr.S Dutta, IMD,	2

3	Numerical method	Finite difference methods and Numerical solution	1. Well posed and ill posed initial value problems. 2. Different finite difference schemes (FDS), viz., forward, backward and leap frog schemes. 3. Compatibility of FDS. 4. Explicit and implicit or semi implicit time differencing schemes. 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 leap frog scheme. 7. Lax equivalence theorem. 8. Numerical approximation of Jacobian and Laplacian. Concept of Arakawa's 9-point Jacobian.	Dr.S Dutta, IMD, Pune	4
4		Spectral method	1. Basic concepts of orthogonal function, Spherical harmonics and orthogonal polynomial. 2. Basic properties of Legendre polynomial 3. Spectral representation of Meteorological field variable. Spectral co-efficient, spectral transform. Basic concepts of spectral method. 4. Triangular and Rhomboidal truncation.	Dr. R.Krishnan, Scientist G, IITM	3
5	Data Assimilation	Objective analysis. Initialization and basics of global data assimilation system.	1. Definition of Objective analysis, its importance and its different types, Viz., Cressman method, Optimum interpolation method, BLUE, Maximum likely hood estimate. To show that BLUE is same as maximum likelihood estimate and is the best estimate.	Dr.S Dutta, IMD, Pune	3
			2. 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	12
			3. Definition of initialization, its importance and it's different types, viz., Static Dynamic, Normal mode, Dynamic normal mode & Physical, Nudging, Synthetic data generation/vortex initialization	Scientists from NCMRWF	

			4. Basic concept of a general data assimilation cycle, Variational data assimilation (3d Var and 4 D var). Introduction to cost function for 3-DVAR as well as for 4-DVAR data assimilation and its minimization, giving rise to analyzed field. Concept of Kalman filtering.	Scientists from NCMRWF	
			5. Processing Doppler Radar Data for quality control and mesoscale data assimilation. Oceanic data assimilation: data assimilation at mesoscale, assimilation of altimetry data.	Scientists from NCMRWF	
			6. Ensemble data Assimilation technique, Hybrid data assimilation technique.	Scientists from NCMRWF	
6	Parameterizations of physical processes	Different Sub-grid scale physical processes and their parameterization	1. Definition with example of sub grid scale physical processes and their influence on grid scale variable. Definition of parameterization of sub grid 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. 3. Dry and moist adiabatic adjustment process. Different cumulus parameterization schemes, Viz., Kuo, Arakawa, Betts Miller, KF schemes etc., their broad aspects, benefits and limitations and inter comparison. 4. Principle of radiative transfer. Gravity wave drag and its parameterization Biosphere and Land surface processes. Parameterizations of air-sea interaction processes. 5. PBL parameterization under different stratification. Concept of mixing length, Von Kerman constant, roughness length, Monin Obukov length etc.	Scientists from IITM, Pune	10
7	Types of Dynamical Models	Different types of Dynamical model based on the equations used.	1. Primitive equation model with different vertical coordinate, viz., p, sigma, terrain following, eta etc. Representation of orography in a model. 2. Derived model, viz., barotropic model, equivalent barotropic model, two-layer baroclinic model and quasi geostrophic model.	Dr. S Dutta, IMD,	2

	Operational forecast model	Operational forecast model for different time scales	1. Global Forecast System model and Global ensemble forecast system model.	Dr.Durai, IMD, +Dr.P.S.Mukhopadhyay, IITM, Pune	2+2=4
			2. Regional and mesoscale forecast system models (WRF, ARPS), Nowcast model,	Dr.A.K.Das+Dr Soma SenRoy. ,IMD	2+2=4
			3. Couple Model (Climate Forecast system), Ensemble prediction system, multi-model ensemble technique, Extended range forecasting.	Scientists from IITM, Pune+Dr. D.R.Pattanaik, IMD	2+2=4
			4. Cyclone model Hurricane WRF, vortex relocation and initialization,	Scientists from NWP division IMD	2
			5. Antarctica model Polar WRF, Air quality model WRF (Chem),	Dr.A. K. Das+Dr.V.K.Soni. IMD, Delhi	2+2=4
	NWP products	Different NWP products, their understanding, interpretation and application.	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	4
			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	4
			4. 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	4
	Hands on practical	Computation using gridded analyzed and forecast field	1. Computation of jacobian and laplacian 2. Numerical method to solve Poison's equation using relaxation method and spectral method. 3. Computation of stream function and velocity potential and their analysis.	Shri. G.K.Sawaisarje, IMD	10

		Introduction to Linux operating system	1. Script writing, 2. an introduction to High Performance Computing System, 3. Pre-processing of observations, Configuration of WRF model with GFS, 4. Experiment with nesting and nest down techniques, data sensitivity experiments, sensitivity experiments for physical parameterization.	Scientists from IITM, Pune	10
		Hands on Practical on data assimilation	1. Simple programs on Cressman technique, Statistical Interpolation. 2. Initialization of numerical models 3. Applications of an operational Variational assimilation scheme in numerical weather prediction (shallow water model). 4. Radar & Satellite Data assimilation, Fog forecasting (onset, duration and dissipation).	Scientists from NCMRWF/IITM	10
		Hands on Practical on Model diagnostics	1. Graphics package for illustration of NWP products, Case study of front, cyclone, localised severe weather with the use of derived products like divergent, vorticity, flow pattern, precipitable water content, vertically integrated moisture flux, rainfall etc. 2. Use of model verification tool MET. Model outputs verification tools/ post-processing : Exercises based on the Verification packages such as MET, MODE, R, etc. Visualization of model outputs based on graphic packages such as VAPOR, NCL and RIP. 3. Computation of time evolution of Zonal and eddy kinetic and available potential energy and their inter conversion, using forecast field for special weather cases.	Shri. G.K.Sawaisarje and Dr.A.K.Das, IMD	10
Total =					108

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5 April to 28 May 2021

Registration form

Ref.: 00596/2021-L1 MS/ETR

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 the same.	
11.	Present Post held	
12.	Name and full address of Employer including country ZIP.	
13.	Area of specialization & field of Study	
14.	Working Experience in terms of years (nominees should possess at least 2 years' experience in forecasting and/or NWP) .	
15.	(Signature) (Name)	

Please return this form to Dr Somenath Dutta, India Meteorological Department, by email (dutta.drsomenath@gmail.com with a copy to rkgiriccs@gmail.com) latest by 31/01/2021.