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| **World Meteorological Organization** | **ETR-PAN-27/Doc. 11** |
| **EC PANEL OF EXPERTS ONEDUCATION AND TRAINING** | Submitted by: | Secretary-General |
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## Agenda Item 4: Identification of WMO human resource development requirements

# 4.2.4 Climate Services education and training

# SUMMARY

### THE PANEL ARE INVITED TO:

1. Recommend additional steps forward for accomplishment of goals in this Global Campus Demonstration activity;

(b) Suggest contributions for the catalogue of ETR resources and activities for climate services;

### CONTENT OF DOCUMENT:

The Table of Contents is available only electronically as a Document Map[[1]](#footnote-1)\*.

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# 4. Identification of WMO human resource development requirements

## 4.2.4 Climate Services education and training (a WMO Global Campus activity)

### Introduction

1. The Seventeenth World Meteorological Congress included activities related to the development of Climate Services in multiple languages as one of the WMO Global Campus demonstration projects. This paper summarises the outcomes from a Curriculum Development Workshop the ETR Office ran at the RTC in Israel in-conjunction with the Climate Prediction and Analysis (CLPA) Branch of the Climate and Water Department and the CCl Expert Team on Education and Training. See Appendix A for the full workshop report, as well as the draft competency framework which was further refined based on input from the meeting and the list of participants.

2. This was the first opportunity for a large group of people with climate services expertise and / or education and training expertise to critically review the draft Climate Service competency framework over an extended time. The important outcomes, conclusions, and proposed next steps arising from the workshop are listed below. The Panel are invited to review the workshop outcomes and then:

* Recommend additional steps forward for the accomplishment of WMO Global Campus Demonstration activity goals
* Suggest contributions for the catalogue of ETR resources and activities for climate services

### 3. Workshop outcomes

* Improvements to the Competency Framework for Climate Services were proposed. The revised version will go to the CCl MG for final approval prior to submission to the WMO EC for inclusion in Volume 1 of WMO Publication 49 as recommended practises.
* Existing ETR activities and resources to support training for the climate service competencies were identified (see Appendix B).
* The group agreed to collect further examples of existing or in-development learning opportunities and map them to the competency framework. The ETR Office has worked with the ET-ETR to identify an initial process consistent with Global Campus activities (see Documents 9 and 11, and Appendix C).
* The group identified that the development and widespread availability of a Climate Services Toolkit (providing a common set of tools for training and operations, access to guidelines, data sources, and application exemplars, as well as a user forum) is a core component for the successful development of competency-oriented training for climate services. A WMO workshop to extend work on the toolkit is planned for July, 2016.
* The group identified important training gaps in the fields of data rescue, climate data management systems, quality control and homogenization, among others. Identification of gaps, including language gaps, will continue as the list of existing training resources mapped to the draft competency framework grows.

### 4. Threats and opportunities

* The workshop was advised that in some NMS’s the need for training in climate services is currently not seen as crucial. Such NMS’s may need further convincing to allocate time and resources for training of their staff in climate service activities.
* In addition to the Climate Services Toolkit, several additional opportunities for collaboration and sharing of resources and approaches were discussed and will require follow up and ongoing support. Several promising opportunities are already in development, including a UCAR-CIMO connection for instruments training, and an adaptation of the IBIMET-created Seasonal Climate Forecasts course for Peru and western South America.
* As in many areas, it remains a challenge to select appropriately prepared trainees and those who have needs and opportunities to apply the skills acquired. Training can be wasted effort unless these conditions are in place.

### 5. Recommendations for ETR solutions

* Training must be oriented toward application of learning in operational settings. Even background knowledge should be taught in the context of its application.
* A variety of learning solutions are required to meet training needs due to the wide scope of climate services and large differences in the existing knowledge and skills of NMS personnel. A combination of formal, semi-formal and informal training is recommended.
* Learning solutions that can reach a wider audience are critical due to financial and time constraints of the NMSs and their personnel. Solutions such as e-learning components and in-country training by roving training teams have a large potential to reach many people.
* It is important to create an ongoing learning community of service providers, users, stakeholders, scientists and trainers to maximize the effectiveness of ETR activities. In addition to developing and maintaining a registry of training resources, this community would require fora for exchanges and collaborations.
* Training events should include three phases: pre-event activities to prepare learners with prerequisite knowledge (and to identify those not prepared or over-prepared), the core learning activities (including opportunities for application and assessment/feedback), and post-event follow up activities (including implementation support and impacts assessment).
* Training should be offered using standardized learning outcomes, tools and materials to assure minimum global services and allow shared development. When possible the training should occur in the native language of the trainees.
* The standard training packages need to be customizable to address local capabilities and needs. Training that assumes and is prepared to facilitate later customization is more highly valued.
* All training events should include a component on communication skills and introduce quality management processes.
* The standard learning outcomes identified when further developing the competency framework and training for climate services will be reviewed for contributing to the potential creation of a climate services Basic Instruction Package.

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# APPENDIX A: Report of the Curriculum development workshop in Israel

The WMO Curriculum Development Workshop for Climate Services took place 21-25 November 2015 in Shefayim, Israel. Its goals were to

* refine the definition and discuss implementation of the CCl-drafted Climate Services Competency Framework,
* identify and review existing ETR initiatives that will contribute to competency development,
* identify clear gaps where new training development is required,
* suggest training approaches that have the greatest potential to achieve high impacts, and,
* discuss an integrated and collaborative training approach aligned with the proposed WMO Global Campus strategy.

The WMO ETR Office and the WMO CCl Expert Team on Education and Training (ET-ETR) jointly organized the meeting. Participants were invited from Members representing key providers of climate services education and training, as well as CCl members and members of the ET-ETR.

**Workshop structure**

The workshop was divided into two parts.

Workshop Part 1

During the first part, WMO and CCl ET-ETR set the context of the meeting by first describing the GFCS classification system. In this system, climate services providers fall into one of the following categories:

* Category I. Basic Climate Services: climate observations, climate data management, interaction with users
* Category II. Essential Climate Services: Category I + seasonal climate outlook and climate monitoring
* Category III. Full Climate Services: Category II + specialized climate products, decadal climate prediction, long-term climate projections
* Category IV. Advanced Climate Services: Category III + customized climate products, climate application tools.

This system, together with the new Climate Services Competency Framework, provides a clear way for identifying training needs, and provides a curriculum path as well.

Also in the first part of the workshop, the Climate Services Competency Framework was described in some depth, the WMO Global Campus concept was introduced as a promising approach to combine efforts on meeting climate services training needs, and the workshop processes were explained.

The longest portion of Part 1 included presentations from represented institutions introducing their key ETR initiatives related to climate services. These initiatives were mapped to the competency framework, although further mapping is required (see outcomes). They provide a strong starting point for a compilation of ETR opportunities in the climate services areas. Appendix C includes a list of ETR projects discussed or referenced during the workshop.

Workshop Part 2

Participants were divided initially into five breakout groups according to their primary expertise, and each group was assigned one of the five high-level competencies to explore in depth. The groups followed a training development planning process that paralleled the WMO Competencies for Training Providers (see WMO-No. 1114), using tools adapted from the WMO Online Course for Trainers.

As they began, each team spent significant time working to fully understand the implications of the high-level competencies and second level Performance Criteria, suggesting many useful revisions to help them in their deliberations. Time did not allow fully completing the process to produce detailed training plans for new initiatives, but many groups did reach the point of specifying learning solutions in their competency area and suggesting designs for learning activities and necessary resources. During the process, existing resources were identified as well.

# On the second day of breakout group work, the group working on the Competency 4 “Ensure the quality of climate information and services” was merged into the other groups to ensure quality concerns were sufficiently addressed throughout. This merger occurred when it was agreed this was a cross-cutting competency, both across the other Climate Services competencies and across other WMO competency frameworks.

## draft competency framework for personnel involved in climate services

**Draft prepared by the WMO-CCl Expert Team on Education and Training.**

The provision of climate services within a country or region, either by one or several National Meteorological and Hydrological Service (NMHS) or other institutions, might be accomplished by a variety of skilled personnel. This includes meteorologists and climatologists, engineers, geographers, statisticians, mathematicians, economists, computer scientists and science communicators, among others. Although each institution designates its particular job roles, climate services provision will involve the transformation of climate data (including in situ, remotely sensed, reanalysis and model output) into climate products and services. This works involves professionals at the managerial level, trainers, ITs, communicators and administrators, and those specifically involved in climate services delivery.

This competencies framework is built to help the institutions to deliver high quality climate services in compliance with WMO standards and regulations, specifically those defined by WMO’s Commission for Climatology and the Global Framework for Climate Services. To achieve this, the institutions (through collective skill of their staff) must demonstrate the following competencies, or an appropriate set of them, according to their mission and institutional capacity.

1. Create and manage climate data sets.
2. Derive products from climate data;
3. Create and/or interpret climate forecasts and model output;
4. Ensure the quality of climate information and services;
5. Communicate climatological information with users.

In a given institution the list of the competencies to be met and the associated performance criteria, would be determined by its infrastructural capacity, although competencies 4 and 5 in the previous list are considered cross cutting competencies and should be met, at least at basic levels, by all institutions providing Climate Services.

The competencies framework is conditioned by:

A. The organizational mission, priorities and stakeholder requirements;

B. The way in which internal and external personnel are engaged in the provision of climate services;

C. The available resources and capabilities (financial, human, and technical) ;

D. National and institutional legislation, rules, organizational structures, policies and procedures.

E. WMO guidelines, policies and procedures for climate data and products

This document, describes each of the above mentioned competencies, including an expanded description of the associated performance criteria and the personnel who should meet these competencies. To avoid conflict within different job categorizations, personnel are represented by broad job roles which are present in most institutions: managers; trainers; ITs, communicators, administrators, climate personnel. The last category refers to those who are routinely involved in climate services as their core task.

**Competency 1: Create and manage climate data sets.**

**Competency description**

Climate data, metadata and climate data products are gathered and stored in datasets, quality controlled and assessed for homogeneity.

**Performance criteria**

* Conduct climate data preservation and rescue procedures;
* Collect and store in relational databases climate data and metadata;
* Apply quality control processes to climate data to identify and evaluate suspect data;
* Assess climate data homogeneity and adjust inhomogeneous time series;
* Create, archive and document climate datasets;
* Apply spatial and temporal interpolation to ensure data continuity.

**Personnel who should demonstrate competency**

This competence should primarily be met by the climate personnel and by the ITs.

**Competency 2: Derive products from climate data**

**Competency description**

Climate data products for science and user applications are derived from different sources of climate data (such as observed and reconstructed time series, reanalysis, satellite and modelled data) applying statistics which describe their spatial and temporal characteristics.

**Performance criteria**

* Identify and retrieve climate data from different sources to generate climate products;
* Compute basic climate products, normals, or anomalies defined relative to a reference period;
* Compute Climate Indices for the monitoring of climate change, climate variability and climate extremes;
* Compute sector-specific Climate Indices and other sector oriented climate products;
* Apply statistical and geo-statistical analysis to monitor the spatial distribution and temporal evolution of climate ;
* Create value-added products, such as graphics, maps and reports to explain climate characteristics and evolution, according to the needs of specific sectors such as health, agriculture, water and disaster management;
* Comply with the standards set and the recommendations made by WMO and its Commission for Climatology.

**Personnel who should demonstrate competency**

* This competency should be primarily met by the climate personnel.

**Competency 3: Create and/or interpret climate forecasts and model output.**

**Competency description**

Climate data, climate data products and climate models output are operated and used to create sub-seasonal and seasonal climate forecasts and future climate projections.

**Performance criteria**

* Create sub-seasonal and seasonal forecast products;
* Select domain, parameterization and scenario to run climate models.
* Locate, select and retrieve climate forecasts and climate models output generated by Regional Climate Centers, Global Producing Centers and other institutions to complement self-produced climate products;
* Create future climate projections using different scenarios;
* Apply statistical and geo-statistical analysis, including downscaling, to monitor the spatial distribution and temporal evolution of model output;
* Evaluate the performance of climate models output and quantify the associated uncertainties;
* Create value-added products, such as graphics, maps and reports to explain climate forecasts and climate model information;
* Comply with the standards set and the recommendations made by WMO and its Commission for Climatology.

**Personnel who should demonstrate competency**

* This competency should be primarily met by the climate personnel.

**Competency 4: Ensure the quality of climate information and services**

**Competency description**

Climate information and services are defined and routinely updated. Best Practices are followed and/or Guidelines and Quality Management Procedures for climate information are created and routinely maintained. Monitoring processes of the climate services are documented and used in quality control activities.

**Performance criteria**

* Define and apply Quality Management procedures for climate services;
* Recruit competent personnel to develop and deliver climate services;
* Ensure that the institution fulfills the requested competences at its infrastructural capacity level and plans a strategy to develop sustainable capabilities.
* Provide training to personnel to fulfill their job requirements and expand their capabilities;
* Define and implement a catalog of climate datasets, products and services, to meet user requirements at the national/regional level.

**Personnel who should demonstrate competency**

This competence affects primarily the managerial level and the trainers within an organization.

**Competency 5: Communicate climatological information with users**

**Competency description**

Climate science, data and products are communicated to policy makers, stakeholders and the general public.

**Performance criteria**

* Prioritize the communication of climatological information according to social, political and economic relevance;
* Establish effective communication channels with climate services users;
* Conduct and evaluate customer needs analysis on a regular basis;
* Revise climate services and their communication based on user feedback;
* Formulate and deliver, in partnership with users, specific applications to facilitate the understanding and use of the climate products and services
* Comply with the interfacing requirements of the GFCS and the integration within the WMO WIS system.

**Personnel who should demonstrate competency**

This competence affects both the managerial level, the climate personnel, the ITs, the communicators and the trainers.

## participants of the curriculum development workshop

* Australia, Yahya Abawi, International Center for Applied Climate Sciences - University of Southern Queensland
* Canada, Jennifer Milton, Environment Canada - Meteorological Service of Canada
* China, Yang Dai, CMATC- China Meteorological Administration Training Center
* China, Yong Wang, NUIST - Nanjing University of Information Science & Technology
* France, Gilles Perret , Meteo France
* France, Jean Pierre Ceron, Meteo France
* Germany, Mark Higgins , EUMETSAT- European Organisation for the Exploitation of Meteorological Satellites
* Ireland, Peter Thorne, Maynooth University
* Italy, Marina Baldi, IBIMET - Institute of Biometeorology
* Kenya, Edward M. Muriuki, IMTR - Institute for Meteorological Training and Research - RTC
* Kenya, Pascaline Chemaiyo, KMD - Kenyan Meteorological Department
* Niger, Amadou M. Laouali, Centre Regional AGRHYMET
* Peru, Teresa Garcia Vilca, SENAMHI - Servicio Nacional de Meteorologia e Hidrologia
* Slovenia, Tanja Cegnar, Slovenian Environment Agency
* South Africa, Charlotte McBride, South African Weather Service
* Spain, Enric Aguilar, Universitat Rovira i Virgili
* Spain, Manola Brunet, Universitat Rovira i Virgili
* Spain, Jose Antonio Guijarro, AEMET - Agencia Estatal de Meteorologia
* Spain, Jesus M. Patan Torres, AEMET - Agencia Estatal de Meteorologia
* Switzerland, Patrick Parrish, WMO - World Meteorological Organization
* Switzerland, Jeffrey Wilson, WMO - World Meteorological Organization
* Switzerland, Rupa Kumar Kolli, WMO - World Meteorological Organization
* UK, Roger Stern, University of Reading - Statistical Services Center
* UK , Rebecca Griffiths, Met Office College
* USA, Marina Livezey, NOAA - National Oceanic and Atmospherical Administration
* USA, Bruce Muller, The COMET Program - University Corporation for Atmospheric Research
* Israel, Giora Gershtein, IMS - Israel Meteorological Service -RTC
* Israel, Avner Furshpan, IMS - Israel Meteorological Service

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# APPENDIX b: Initial inventory of ETR resources for training in climate services

Competency Framework for Climate Services Personnel

1. Create and manage climate data sets.
2. Derive products from climate data;
3. Create and/or interpret climate forecasts and model output;
4. Ensure the quality of climate information and services;
5. Communicate climatological information with users.

International training resources identified during and after the workshop, and primary competencies addressed

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Institution | Course or resource | C1 | C2 | C3 | C4 | C5 |
| RTC Peru/MeteoSwiss | Climandes project (Courses and capacity development strategy) | x | x |  | x | x |
| RTC Peru/U of Bern | Climandes project (e-Learning resources) | x | x | x | x |  |
| RTC Italy (IBIMET) | Seasonal Climate Prediction Course |  | x | x | x |  |
| RTC Italy (IBIMET) | Climate Change Adaptation and DRR in Agriculture (courses and mentoring project) |  | x | x | x | x |
| RTC Israel | Climate Change and Agriculture (annual course) |  | x | x |  | x |
| RTC Kenya | Capacity Building for Provision of Country Climate Information Services (courses and programme) | x |  |  |  | x |
| RTC China (Beijing) | Climate Services: Climate monitoring, prediction, and application (course) | x | x | x | x |  |
| RTC China (Beijing) | Global Framework for Climate Services (course)  |  | x | x |  | x |
| RTC Niger (AGRHYMET) | Professional Master’s Degree Programmes (Climate change and sustainable development, Integrated mgt. of environment and water resources, Management of sustainable lands, Sustainable protection of culture and environment, Food security and nutrition) |  |  | x |  | x |
| RTC India (IMD, Pune) | Advanced Meteorology Curriculum (BIP-M), Climatology and Climate Science Courses |  | x | x |  |  |
| RTC Russia (RSHU) | Summer School, Economic, Social, and Humanitarian Aspects of Climate Change |  |  |  |  | x |
| Météo-France | Climatology, Foundation for climate services (annual course) | x | x |  | x |  |
| Met Office College (UK) | Climate Change impacts courses |  |  | x |  | x |
| Met Office College (UK) | Precis, regional climate modelling (workshop) |  |  | x |  |  |
| EUMETSAT | Climate Monitoring Satellite Application Facility (CM-SAF) (multiple efforts) |  | x | x |  |  |
| Met Service of Canada | Competency assessment for Climate Services needs |  |  |  | x |  |
| Met Service of Canada | Decision support training for weather preparedness |  | x |  |  | x |
| AEMET (Spain) | Climate services training (National, but there is a goal to offer to IberoAmerica) | x | x |  | x |  |
| Maynooth University | MsC on Climate Change | x | x | x |  |  |
| University of Reading | e-SIAC (Statistics in Applied Climatology) |  | x | x | x |  |
| University of Reading | African Data Initiative |  | x |  |  |  |
| University of Reading | Instat open-source software upgrade |  | x |  |  |  |
| Center for Climate Change (URV, Spain) | ET-TCDI workskhops on climate indices | x | x |  |  |  |
| The COMET Program | 39 Lessons on MetEd related to climate models, statistics, climatology, climate variability, climate change, and water resources, among others.  |  | x | x | x | x |
| The COMET Program | Water Temperature Impacts Under Climate Change (course) |  |  | x |  | x |
| The COMET Program | Hydrologic Impacts Under Climate Change (DL course) |  | x | x |  | x |
| The COMET Program | Climate Variability and Change (DL course) |  |  | x |  | x |
| The COMET Program | Climatology: Climate Variability and Change for Tropical Ocean Regions (course in development) | x |  | x |  | x |
| WMO | Climate Services Tool Kit (in planning) | x | x | x | x | x |

# APPENDIX C: Form for gathering climate services education and training resources

**Google Form: Climate Services Education & Training Resources**

(see https://docs.google.com/a/wmo.int/forms/d/1vYi8izZB0X55QXB\_X-ZlyzLaiHQgcsANjS1Mwe6bnfM/viewform)

Contribute a description of your course or resource to allow us to fully map what is available globally to be used for climate services training.

\*Required

 Course or Resource Title \*

 Course/Resource Description \*

 Institution(s) offering the course or resource \*

 Location

 Indicate venue, city, country. For e-learning that is not specific to a country or region, indicate "e-learning".

 Learning Solution (Delivery Format) \*

 On-site

 e-Learning

 Blended (mixture e-learning/on-site)

 Other:

 Expected learning outcomes \*

 Certificate or Diploma offered \*

 Contacts \* Who can provide additional information? (email address if possible)

 This resource is addressed to: \* Choose one or more of the following

 NMHSs personnel

 Graduate Students

 Undergraduate Students

 Climate Services Users

 Other:

 WMO Languages used \*

 English, French, Spanish, Chinese, Arabic, Russian

 Other languages

 URL for more information

 Frequency offered (Courses)

 Publication or Revision date (Resources)

 Fees, if applicable

Climate Services Education & Training Resources

\*Required

 **Competencies Addressed**

 Describe how each competency is addressed. "Well treated" indicates that one or more of the second-level competencies is fully or substantially treated. "Limited treatment" indicates that a competency is a secondary learning outcome.

 1.0 Create and manage climate data sets

 This competency includes:

 1.1 Conduct climate data preservation and rescue procedures

 1.2 Collect and store in relational databases climate data and metadata

 1.3 Apply quality control processes to climate data to identify and evaluate suspect data

 1.4 Assess climate data homogeneity and adjust inhomogeneous time series

 1.5 Create, archive and document climate datasets

 1.6 Apply spatial and temporal interpolation to ensure data continuity

 1.0 Create and manage climate data sets \*

 Well treated

 Limited treatment

 Not treated

 Comments on 1.0 (such as subcompetencies addressed)

 2.0 Derive products from climate data

 This competency includes:

 2.1 Identify and retrieve climate data from different sources to generate climate products

 2.2 Compute basic climate products, normals, or anomalies defined relative to a reference period

 2.3 Compute Climate Indices for the monitoring of climate change, climate variability and climate extremes

 2.4 Compute sector-specific Climate Indices and other sector oriented climate products

 2.5 Apply statistical and geo-statistical analysis to monitor the spatial distribution and temporal evolution of climate

 2.6 Create value-added products, such as graphics, maps and reports to explain climate characteristics and evolution, according to the needs of specific sectors such as health, agriculture, water and disaster management

 2.0 Derive products from climate data \*

 Well treated

 Limited treatment

 Not treated

 Comments on 2.0 (such as subcompetencies addressed)

**Etc. for each competency**

#

1. \* In MS Word 2007 or 2003, go to “View” > “Document Map”. In MS Word 2010, go to “View” > “Navigation Pane”.
In MS Word on a Mac, go to “View” > “Navigation Pane”, select “Document Map” in the drop-down list on the left. [↑](#footnote-ref-1)