C A R I B B E A N
M E T E O R O L O G I C A L
O R G A N I Z A T I O N

REPORT OF THE

ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES

Basseterre, St. KITTS and NEVIS

14 NOVEMBER 2018

INTRODUCTION

1.1 At the kind invitation of the Government of St. Kitts and Nevis, the 2018 Meeting of Directors of Meteorological Services was held at the Ocean Terrace Inn, Basseterre, in St. Kitts on Wednesday 14 November 2018, under the Chairmanship of Mr Tyrone Sutherland, Coordinating Director of the Caribbean Meteorological Organization (CMO).

1.2 The Meeting fixed its hours of work and determined the order in which it would conduct its business.

1.3 The Agenda adopted by the Meeting is attached as **ANNEX I** and the list of participants and observers attending the Meeting is attached as **ANNEX II** to this Report.

STATUS OF ACTIONS FROM THE PREVIOUS MEETING
(Agenda Item 2)

2.1 The CMO Headquarters produced a single document containing an ***Action Sheet*** that allowed the Meeting to follow-up on the actions taken to implement the decisions of its previous meeting, and to discuss any further actions if required.

2.2 In this regard, a summary of the decisions of DMS2017 (Antigua, 2017) was prepared by the CMO Headquarters. The Science and Technology Officer gave the status of actions taken to implement the decisions to the Meeting.

2.3 The Meeting recalled that the Science and Technology Officer was charged by the 2017 Meeting of the Directors of Meteorological Services to investigate and resolve the issue of the unfavourable results of the Special Main telecommunication network Monitoring (SMM), which showed the results of a comparison between observations received at the Main Telecommunication Centres (MTNs) in Traditional Alphanumeric Code (TAC) and Table Driven Code Forms (TDCF), for the period 1-15 January and 1-15 April 2017. The matter was investigated with Regional Telecommunication Hub (RTH) Washington and names of the countries which have filed "a request for change" for their TCDF files to be stored and retrieved from RTH Washington was provided to the Meeting.

2.4 The **Director, Antigua and Barbuda Meteorological Service** suggested that there was a need for a regional solution to be implemented so that all synoptic observations could be encoded in TCDF. The Meeting was reminded that a solution was proffered to the region using a Linux based encoder/decoder developed by the European Centre for Medium-Range Weather Forecasts (ECMWF), with a Graphic User Interface developed under the auspices of the Caribbean Meteorological Organization and this was provided to the Meteorological Services from 2014.

2.5 Two solutions were offered to the Meeting to address the issue, which were:

1. The Meteorological Service of Member States to request assistance from CMO in the development of technical specifications for new workstations to replace the existing workstations, which cannot be upgraded to encode synoptic observations in TDCF. Further, the technical specifications would also ensure that the systems purchased could encode aeronautical data (observations, forecasts and SIGMETs) in Geography Markup Language (GML) format, which would be required for the transmission of aeronautical observations, forecasts and SIGMETs from 5 November 2020.
2. The Services could pool resources, both human and otherwise, to create an encoder/decoder unique to the Member States which operates in a Windows® environment.

TRAINING
(Agenda Item 3)

3.1 Ms Kathy-Ann Caesar, Chief Meteorologist, Caribbean Institute for Meteorology and Hydrology (CIMH) gave a presentation on the Meteorological Training offered at the Institute. The presentation provided information on the courses which were completed by the Meteorological Section, the certificates, which were obtained by the participants, the number of passes, conditional passes, failures and incomplete courses. Information was also provided on the quality of the passes.

3.2 The Meeting was informed about the WMO Global Campus, which is a collaborative network of WMO Member institutions and National Meteorological Hydrological Services involved in the development and delivery of education and training. The goal of the Global Campus was to address the evolving global priorities for learning. It is based on the WMO Regional Training Centres and other WMO-designated centres engaged in learning activities, but embraces all institutions contributing to the learning needs of WMO Members.

3.3 WMOLearn is the communication mechanism for the Global Campus. It would provide portals for sharing and discovering learning events and resources, as well as information about collaborative projects. The Meteorology Section of CIMH would be listing its resources in the WMO E-Library and would also need to review and implement practices such as those recommended by the "WMO Global Campus Copyright Practice Standards".

3.4 The Meeting was reminded of the University of the West Indies' requirement that all 4-credit courses be restructured to 3-credit courses. It was informed that two Physical Meteorology Level 2 courses were converted from 4 credits to 3 credits. Thereby, fulfilling one of the two conditions of its agreement with the University, to allow the programme to have most of its Level 2 and Level 3 courses to remain at 4 credits.

3.5 The Meeting was informed that the following meteorological training would be undertaken in 2019:

(a) Providing a training workshop on the use of GOES-16 and JPSS imagery along with NOAA;
(b) Providing training for the SWFDP project in the areas of mesoscale forecasting and severe weather warning;
(c) Implementing training for weather impacts in the Weather and Climate Ready Nation (WRN) project;
(d) Providing additional classes in Aerosols, Dust and Pollutants to the curriculum of the UWI and SLMT courses utilizing training gained at the School of Atmospheric Measurements in Latin America and the Caribbean (SAMLAC): Reactive Gases and Aerosols workshop.

3.6 Ms Caesar informed the Meeting that during the next one to two years the Meteorological Section of CIMH would be undertaking these main tasks as it relates to is courses:

- *Complete the 3-credit conversion of the remaining UWI Meteorology courses:* - It was expected that two Synoptic Meteorology courses would transition to 3-credit courses. Weather Radar and Satellite would separate into two (2) courses; additionally, there was the need to create two (2) courses to cover topics dropped from other courses.
- *Integrate new technology into the courses*: - The regional Meteorological Services are integrating new technologies into their operations. The Section would need to ensure that the course curricula were in line with what was operationally relevant.

- *Map all the course curricula to WMO Skills Guidelines and Competencies:* - WMO would be developing a series of Competency Frameworks and Skills Guidelines. Therefore, the CIMH courses would be mapped as to what skills are to be met upon completion of all courses.
- *Develop further Continuing Professional Development (CPD) Curricula for all WMO Aeronautical courses:* - CIMH need to prepare a CPD curriculum for all Aeronautical Meteorological Personnel (AMPs), including CPD courses for lecturers.

3.7 The Meeting discussed the possibility of reducing the length of the SLMT course from its present length of 18 months to between 9-12 months. It was noted that if the course was reduced there would be a need for the prospective students to be certified as having the necessary Mathematics and Physics qualification at the SLMT level. This would be easy to ascertain for prospective students with BSc degrees in Mathematics and Physics, however, prospective students with other certifications would need to complete and attain a passing grade in an online pre-requisite mathematics course, in order to meet required quality management system requirements. The Meeting decided that the reduction in the length of the SLMT required further deliberation.

3.8 Ms Caesar requested that the Meeting give consideration for a hiatus for the 2020-2021 Senior-level Meteorological Technician (SLMT) course only, based on the workload identified in paragraph 3.6 and their workload and representation at the regional and the international levels. After deliberation, the Meeting agreed that there would be no SLMT course offered during the 2020-2021 period.

OPERATIONAL MATTERS
(Agenda Item 4)

4.1 The Meeting noted that some Meteorological Services of the Member States that have stations in the Regional Basic Synoptic Network (RBSN) did not participate in the World Meteorological Organization (WMO) Annual Global Monitoring (AGM), which monitors the data disseminated over the Global Telecommunication Service (GTS). There are ten (10) Members States of the Caribbean Meteorological Organization whose National Meteorological Service (NMS) are RBSN stations. These are Antigua and Barbuda, Barbados, Belize, the Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Saint Lucia and Trinidad and Tobago.

4.2 The Meeting was also presented with the results of the 2017 AGM from WMO's data archive at **ftp://ftp.wmo.int/GTS_monitoring/AGM/To_WMO/201710**, which shows that Antigua, Barbados, Grand Cayman, Dominica and Jamaica submitted results of their monitoring for the AGM in 2017. The results which were presented for the monitoring of SYNOP, TEMP and CLIMAT reflected for the most part, the reports from the RTH and Main Telecommunication Network (MTN) centres and the results showed that for the SYNOP code from the thirteen (13) offices reporting from the Member States, nine (9) were within the 90-100% range, and four (4) were in the 45-90% range.

4.4 All of the upper-air stations, with the exception of the Cayman Islands, were within the 90-100% range. No CLIMAT reports were received from Barbados, Belize, Cayman Islands and Piarco, Trinidad during the AGM period in 2017 and they were deemed to be silent.

OUTCOME/HIGHLIGHTS OF THE SEVENTIETH MEETING OF WMO EXCUTIVE COUNCIL
(Agenda Item 5)

A. WMO Constituent Body Reform

5.1 The Seventeenth WMO Congress (Cg-17) in 2015 requested the Executive Council (EC) to continue to introduce specific measures for improvement of WMO processes and practices. It further requested the EC provide recommendations to the Eighteenth Congress on constituent body constructs, as appropriate, including possible new structures for Technical Commissions (TCs), Regional Associations (RAs), EC, and also to provide recommendations on rules, procedures, processes, mechanisms, and duties of constituent bodies, WMO Officers (President, Vice-Presidents, Presidents of Regional Associations (PRAs) and Presidents of Technical Commissions (PTCs) and the relationship between them and the WMO Secretariat, in order to enhance the efficiency and effectiveness of the Organization and good governance.

5.2 The EC WG-SOP made the following recommendations to the seventieth session of the Executive Council, (Geneva; June 2018), which were approved:

a) To establish two standing bodies which would report to EC:
   i. A Policy Advisory Committee (PAC);
   ii. A Technical Coordination Committee (TCC).

b) To establish, in accordance with Article 8 (g) of the Convention, the following technical commissions for the nineteenth financial period:
   i. Commission for Earth System Observation, Infrastructure and Information (COIIS);
   ii. Commission for Weather, Climate, Water and Related Environmental Services and Applications (CSA);

c) That the two technical commissions shall commence their work as early as possible in accordance with the Transition Plan;

d) That, in accordance with the final paragraph of Article 8 of the Convention, the president of each new commission and their vice-presidents would be elected by Congress, from amongst current presidents and vice presidents of technical commissions, as a one-time measure aimed at expediting the transition to the new structure of the technical commissions;

e) Upon completion of the transition period, to disband the existing technical commissions that have been active during the eighteenth financial period:
   i. Commission for Basic Systems (CBS);
   ii. Commission for Instruments and Methods of Observation (CIMO);
   iii. Commission for Hydrology (CHy) (pending CHy-Ext Recommendations);
   iv. Commission for Atmospheric Sciences (CAS);
   v. Commission for Aeronautical Meteorology (CAeM);
   vi. Commission for Agricultural Meteorology (CAgM);
   vii. Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM);
   viii. Commission for Climatology (CCl).

B. WIGOS Data Quality Monitoring System (WDQMS)

5.3 The Meeting was reminded that all Members should be “WIGOS Ready” per the Plan for the WIGOS pre-operational phase, this includes:

(a) OSCAR/Surface: completed WIGOS metadata of all observing stations across all WIGOS components for which observations were to be exchanged internationally;

(b) WIGOS metadata: compliance achieved;

(c) WIGOS Station Identifiers: implemented;

(d) WIGOS Data Quality Monitoring System (WDQMS): national process for acting on quality problem information received from the WDQMS in place.

5.4 The Meeting was shown the results of the pilot project to demonstrate the WIGOS Data Quality Monitoring System (WDQMS). The WDQMS the data ingested (surface pressure and TEMP reports) into numerical weather prediction models at four centres, which are the Deutscher Wetterdienst (DWD), the European Centre for Medium-Range Weather Forecasts (ECMWF), Japan Meteorological Agency (JMA) and the *National Centers for Environmental Prediction (NCEP)* with the Members' information, which *is stored in OSCAR/Surface.*

5.5 It was noted that the results for Meteorological Services of Member States were generally approximately 30% of the expected number of surface observations. However, the expected number of surface observations was 24 per day, but for the most part the Meteorological Services only reported 6 to 8 synoptic observations per day depending on their hours of work. It was suggested that Meteorological Services that can transmit all of their synoptic observations encoded during their hours of work per day with the required WMO header for main, intermediate and non-standard synoptic hours, should. CMO would assist any Meteorological Service in the completion of a “Request for Change” form to be submitted to the RTH Washington to add additional coded non-standard synoptic hour observation to the GTS.

C. Aeronautical Meteorology

5.6 EC-70 approved a Resolution which amended WMO Technical Regulation (WMO No. 49) Volume II *Meteorological Service for International Air Navigation*, which ensured its necessary alignment with Amendment 78 to Annex 3 of the ICAO Convention that would come into force in November 2018.

5.7 EC-70 approved a Resolution which amended WMO Technical Regulation (WMO No. 49) Volume I, *General Meteorological Standards and Recommended Practices, Part V*, which provided the top-level competencies for a pubic weather service forecaster. The competencies are provided in **Annex III**.

OUTCOME/HIGHLIGHTS OF THE SIXTEENTH MEETING OF THE COMMISSION FOR AERONAUTICAL METEOROLOGY

(Agenda Item 6)

A CAeM Global Survey

6.1 Ms Kathy-Ann Caesar, Co-Chair, CAeM, Expert Panel on Education, Training and Competency presented the results of the CAeM global survey of aeronautical meteorological service provision, which was conducted between November 2016 and February 2017 to the Meeting. The objective of the survey was to establish a comprehensive, consolidated global view on the existing institutional arrangements for the provision of meteorological services to international air navigation, particularly at a national level, taking into account the supporting ICAO and WMO regulatory frameworks.

6.2 The survey focused on the ICAO/WMO service provision functions of Meteorological Watch Office (MWO), Aerodrome Meteorological Office (AMO) and Aeronautical Meteorological Station (AMS).

6.3 Globally 68% of States and Territories and the Aeronautical Meteorological Service Providers (AMSPs) have a fully implemented QMS. In 14% of the cases QMS is partially implemented, and 9% is unknown or did not respond. In a further 9% of States and Territories there has been no implementation. The reasons provided for partial or zero implementation of QMS were a lack of funding and/or human resources and/or low priority of the government. WMO Regional Association IV (North and Central America and the Caribbean) has the lowest full QMS implementation, only 50%.

6.4 Globally, approximately 70% of States and Territories have established a national competency programme for aeronautical meteorological personnel. No programme was in place in 10% of States, the status was unknown for another 10% of Members, and 10% of Members provided other information, mainly describing their plans with regard to competency assessment.

6.5 Further approximately 40% of Members indicated that their AMSPs were fully compliant with the WMO qualification standard for aeronautical meteorological forecasters (AMF). Forty percent of Members indicated that 50% to 99% of their AMFs were compliant, for 12% of Members less than half of their AMF comply, and the status is unknown for 10% of Members.

6.6 The Meeting was reminded that personnel who graduated from all of the CIMH Basic Instruction Package (BIP) Meteorological Technician courses were qualified. However, for them to remain competent there would need to be regular review of their competency and remedial action where necessary.

6.7 The **Principal** offered to have the CIMH create a training database whereby data on courses attended and certification achieved by meteorological personnel of Meteorological Services of Members would reside. Further, Meteorological Services were to submit their training plans for the foreseeable future. This would enable the CIMH to plan refresher courses and courses for new personnel. The **Director, Jamaica Meteorological Service,** requested that CIMH create a template for the submission of the historical training data, thereby reducing errors with the data input. The creation and filling of the training database must be completed before WMO Congress. Hence, the Meeting mandated the Meteorological Services, CIMH and CMO HQ to work expeditiously to have it completed.

B. Aircraft Meteorological Data Relay (AMDAR) and other instruments and methods of observation

6.8 The Meeting was informed that the International Air Transport Association (IATA) secretariat approached the World Meteorological Organization (WMO), at the behest of its member airlines, that it had undertaken a study on the operation of the WMO Aircraft Meteorological Data Relay (AMDAR) programme and had made the following recommendations:

(a) IATA to work with WMO to expand the AMDAR programme across the globe and establish a more equitable cost-recovery mechanism for the participating airlines; and

(b) IATA to set up a global turbulence database with real-time data transmission to airlines during flight operations.

6.9 It was decided to establish a Working Arrangement between IATA and WMO on the operation of the AMDAR Programme. Under the Working Arrangement, the two organizations would work

together to develop the terms of reference and concept of operations, based on which a future collaboration on AMDAR might be defined and later approved by a subsequent decision of the Executive Council and Congress. The Working Arrangement was formally established in July 2017.

6.10 The **Director**, **Antigua and Barbuda Meteorological Service** inquired as to the cost of the equipment for making and transmitting the AMDAR observations. The Meeting was informed that before cost could be ascertained, the approach should be to brief the policy makers within their line Ministry for meteorology and together with personnel from the line Ministry discuss the matter with their national airline. The airlines incorporated within the Caribbean are Caribbean Airlines, Cayman Airways and LIAT Airlines.

C. Instruments and methods of observation

6.11 It was acknowledged that there was a need for improved coordination and collaboration between the Commission for Aeronautical Meteorology (CAeM) and the Commission for Instruments and Methods of Observation (CIMO) in the context of meteorological observations supporting international air navigation. For example, in the guidance on meteorological observations at aerodromes and (increasingly) in the terminal area could be improved or developed, including in the context of automated observing systems, and there also needs to be a way to direct periodic aviation-specific enquiries on instruments and methods of observation to persons with the necessary level of expertise to respond.

D. WMO Information System (WIS) and interoperability with ICAO SWIM

6.12 The Commission for Basic System (CBS) has continued to support the development and implementation of the ICAO Meteorological Information Exchange Model (IWXXM) as a data format for reporting aeronautical meteorological information in XML/GML. ICAO has been developing its system-wide information management (SWIM) environment that would include meteorological information as one component.

6.13 In preparation for the SWIM environment and at the request of ICAO, for the past several years, WMO has been developing the IWXXM. The IWXXM was the data model chosen for representing aeronautical meteorological information in SWIM and the technical specifications of IWXXM were included in the *WMO Manual on Codes* (WMO-No. 306), Volume I.3, Part D – Representation Derived from Data Models. The agreed format for the operational exchange of information in the SWIM environment, including meteorological information, is XML/GML.

E. Tropical cyclone developments of relevance to aviation

6.14 SIGMETs are issued by Meteorological Watch Offices (MWO) about the occurrence, or expected occurrence, of specified enroute phenomena which may affect the safety of aircraft operations. SIGMETs are of highest priority among other types of meteorological information provided to aviation users, supporting pre-flight planning and in-flight re-planning. To encourage implementation, there was a recommendation for establishing an agreement at the national level for coordination between civil aviation and meteorological authorities

F. Education and training developments of relevance to aviation

6.15 The WMO competency standards for aeronautical meteorological observers (AMO) and aeronautical meteorological forecasters (AMF) were the first WMO competency frameworks to be approved in 2013 and included in WMO-No. 49, *Technical Regulations*, Volume I, *General Standards and Recommended Practices*. Since then, additional frameworks have been implemented by WMO,

with several additional frameworks under development. This has prompted the publication of the *WMO Guide to Competency* (WMO-No. 1205) in early 2018. This Guide covers competency assessment practices, competency documentation, and competency-based training. In addition, it discusses the process of developing or adapting a competency framework.

6.16 The qualification requirement that an AMF has successfully completed the relevant parts of the Basic Instruction Package for Meteorologists (BIP-M) was introduced by WMO as a recommended practice in 2013 and elevated to a Standard in 2016. The WMO ETR Office requested EC-70 (June2018) to approve a review plan for the BIP-M and BIP-MT to consider any needs for updating based on scientific advances and changing roles of operational weather forecasters and changing service delivery requirements.

G. WMO Regulatory and Guidance Material

6.17 Within the WMO and ICAO regulatory frameworks for aeronautical meteorological service provision, there is currently duplication between WMO-No. 49, *Technical Regulations*, Volume II – Meteorological Service for International Air Navigation, and ICAO Annex 3, Parts I and II. These publications are essentially identical. Arising from a bilateral meeting between the WMO Secretary General and the ICAO Secretary General in April 2017, it was recommended that the two organizations seek opportunities to improve efficiency, including potentially eliminating WMO-No. 49, Volume II.

6.18 At the CAeM 17th Session (Exeter, United Kingdom), the Commission:

Recommended that WMO, in coordination with ICAO, should:

(1) Undertake steps necessary to discontinue *Technical Regulations* (WMO-No. 49), Volume II while ensuring that any material of continuing relevance is reviewed before being transferred to other (new or existing) regulatory or guidance material of WMO or ICAO;

(2) Ensure, during the accomplishment of (1), that:

(a) Any WMO or ICAO regulatory and/or guidance material that cross-references WMO *Technical Regulations* (WMO-No. 49), Volume II is appropriately amended; and

(b) Members are kept fully informed of the relevance and availability of this material as well as other relevant ICAO provisions.

Requested the Secretary-General to keep ICAO informed of these developments and, in consultation with ICAO, explore means to enable free access, preferably online, to relevant ICAO regulatory and guidance material by all WMO Members and their NMHSs providing meteorological service for international air navigation.

IMPACTS OF WEATHER DURING 2018

(Agenda Item 7)

7.1 During 2018, although there were significant weather events which led to socio-economic losses in some of CMO Members States, the impacts were relatively benign when compared to the destruction of 2017.

7.2 **Jamaica** experienced **flooding** on the northern side of the island associated with the passage of two fronts in January. The first frontal system produced rainfall for the period 4-9 January, with strong winds which caused power outages, there were flooded roads and landslides, the rainfall from this event was 456 mm. On 9 March, in the Montego Bay area, there was another event which produced 113 mm of rainfall and localized flooding. There were other events in May and September. The rainfall in September was associated with the remnants of **tropical storm Isaac** which produced 235 mm of rainfall over a two-day period. The remnants of **tropical storm Kirk** produced rainfall and **flooding** during the period 1-5 October. There was **one death** associated with the flooding from Kirk.

7.3 On 1 August, a tropical wave was interacting with the Intertropical Convergence Zone (ITCZ) within an abundance of moisture. This produced continuous precipitation across most of **Grenada** with the most intense periods falling across the southern part of the Island. Several observation stations received more than 100 mm of rainfall, with the highest rainfall, measuring 173 mm, occurring at Vendome in St. Georges. The rainfall led to **flooding** and **one death**. There was also a flood event in September in Carriacou.

7.4 **Barbados** was affected by **Tropical Storm Kirk** during the period 27-28 September. Kirk produced strong winds which gusted to tropical storm strength on the extreme southern side of the island and rainfall totals of 255.5 mm at Charnocks, with similar amounts recorded across other nearby southern sections of the island while the northern and central parts of the island recorded rainfall averaging 125 mm. **Severe flooding** was reported in some sections of the island and there were some downed power lines and brief power outages in some areas along with isolated incidents of fallen trees.

7.5 **Tropical Storm Kirk** affected **Saint Lucia** from the evening of 27 September to the morning of 28 September. It was predominately a wind event with stations recording winds averaging 40 kt with gusts to 52 kt. The winds caused the loss of approximately **80% of the banana and plantain crops**, damage to school buildings, disrupted electricity and telecommunications, caused rough seas and damaged an anemometer at the airport in Hewanorra. There was a rainfall event on 9-10 November due to a combination of meteorological factors, which produced rainfall totals in excess of 200 mm over most of the island which resulted in localized flooding, landslides, downed trees and disruption in the water supply.

7.6 **St. Vincent and the Grenadines** was placed under a tropical storm watch on 26 September associated with the passage of **Tropical Storm Kirk**. The center of Kirk passed 50 miles to the north of St. Vincent and produced 46.8 mm of rainfall over the 48-hours associated with it passage. The maximum gust of 27 kt was measured at Argyle. There was some **riverine flooding** associated with the passage of Kirk, three families had to be relocated due to **coastal inundation** and **two fishermen** have gone **missing** while crossing from Canouan to St. Vincent. From 17-22 October, there was **flooding, landslides** and **rock falls** associated with a tropical wave and upper-level trough. An automatic weather station in Arnos Vale reported 73.2 mm of rainfall over a 3-hour period on 17 October and in total there 232 mm of rainfall over the period.

7.7 On 17-19 October, **Trinidad and Tobago** experienced **torrential rainfall** in Trinidad. According to the Office of Disaster Preparedness and Management (ODPM), it was estimated that **80% of Trinidad** was affected by **flooding,** primarily the north, east and central parts of the island. The ODPM estimated that flooding impacted between 100,000 to 150,000 persons, along with several farms and agricultural fields. However, there was no loss of life. The 3-day accumulated rainfall, for the period 19-19 October, exceeded the normal rainfall totals for the month, with the northeastern areas of Trinidad having accumulated rainfall totals between 250-350mm. The rainfall event was

associated with an active ITCZ, upper-level divergence along the Subtropical Jet, and the wet phase of an equatorial Kelvin wave.

PRESENTATION
(Agenda Item 8)

Introduction to Multi-Radar/Multi-Sensor: A data fusion system for improved detection of severe weather, hydrometeorological, and aviation hazards.

8.1 Dr. Heather Reeves of NOAA National Severe Storms Laboratory (NSSL) gave a presentation which highlighted the Multi-Radar/Multi-Sensor (MRMS) system. The MRMS system combines data streams from multiple radars, satellites, surface observations, upper air observations, lightning reports, rain gauges and numerical weather prediction models to produce a suite of decision-support products every two minutes. Because it provides better depictions of high-impact weather events such as heavy rain, snow, hail, tornadoes, and other threats, forecasters can quickly diagnose severe weather and issue more accurate and earlier forecasts and warnings.

8.2 MRMS Quantitative Precipitation Estimation (QPE) uses the most advanced polarimetric radar technologies and provides high-resolution information about precipitation types and amounts for the nation. Many government agencies, universities, and private companies use the products for flash flood and river flood warnings and water resources management in the United States.

8.3 NSSL's Flooded Locations and Simulated Hydrographs (FLASH) project uses rainfall data from MRMS as input into a hydrologic model to produce flash-flooding forecasts up to 6 hours in advance with a 5-minute update cycle.

8.4 NSSL has made initial connections with the Belize Meteorological Service and the Cayman Islands National Weather Service to make use of the radar data for the creation of QPE estimates within a pilot project for the Caribbean Region. NSSL was interested in connecting with other meteorological services that host radar sites within the Caribbean for the sharing of level-2 radar data if they have the capability of using a Local Data Manager (LDM) system, a system which included network client and server programs designed for event-driven data distribution or NSSL can provide a machine which would stream the data over the Internet provided there was enough bandwidth.

8.5 The **Principal**, **CIMH** enquired whether there would be an opportunity for meteorological services which were participating to co-develop products with, rather than just receive products from, NSSL in an effort to build capacity. The Meeting was informed that could happen but there were some propriety products for which a subscription was needed for access.

OTHER MATTERS
(Agenda Item 9)

9.1 The **Director, Antigua and Barbuda Meteorological Service** informed the Meeting that according to the tenets of the quality management system for aeronautical meteorology it was necessary for back-up arrangements to be identified and a service level agreement signed between the parties of the arrangement. To this end there was some discussion between the Director, Antigua and Barbuda Meteorological Service and the Director of the Barbados Meteorological Service, which has led to an initial draft of the service level agreement. The CMO would assist both parties during 2019 to revise the agreement with the assistance of the selected Directors of Meteorological Services, in order that the agreement would be presented to the next meeting of the Directors of Meteorological Service.

Annex I

PROVISIONAL AGENDA

1. INTRODUCTION AND ADOPTION OF AGENDA
2. STATUS OF ACTIONS FROM THE PREVIOUS MEETING
3. TRAINING
4. OPERATIONAL MATTERS
5. OUTCOME/HIGHLIGHTS OF THE SEVENTIETH MEETING OF WMO EXECUTIVE COUNCIL
   - (a) WMO Constituent Body Reform
   - (b) WIGOS Data Quality Monitoring System (WDQMS)
   - (c) Meteorological Services for Aviation
   - (d) Public Weather Services - Competencies
6. OUTCOME/HIGHLIGHTS OF THE SIXTEENTH MEETING OF THE COMMISSION FOR AERONAUTICAL METEOROLOGY.
7. THE IMPACTS OF WEATHER DURING 2018
8. PRESENTATION

   Introduction to Multi-Radar/Multi-Sensor: A data fusion system for improved detection of severe weather, hydrometeorological, and aviation hazards

OTHER MATTERS

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ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES
ST. KITTS AND NEVIS
14TH NOVEMBER 2018

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FUNDAMENTAL WMO COMPETENCY REQUIREMENTS FOR PUBLIC WEATHER FORECASTERS

The competency requirements for the work of personnel engaged in operational forecasting[1] can be divided into five top level competencies, taking into consideration the conditions (a) to (c) below:

(a) The nationally-defined PWS[2] areas of responsibility;
(b) Meteorological and hydrological impacts on society;
(c) Meteorological and hydrological user requirements, local procedures and priorities.

A PWS Forecaster should have successfully completed the BIP-M[3] (as defined in the revised *WMO-No. 49, Volume I*). Taking into account conditions (a) to (c) above, they should also be competent to perform the tasks defined through the five top level competencies, as follows:

(1) Analyse and continually monitor the evolving meteorological and/or hydrological situation;
(2) Forecast meteorological and hydrological phenomena and parameters;
(3) Warn of hazardous meteorological and hydrological phenomena;
(4) Communicate meteorological and hydrological information to internal and external users;
(5) Ensure the quality of meteorological and hydrological information and services.

Each of these top-level competencies is expanded into performance criteria that are expressed and structured in such a manner as to facilitate the clear application of an assessment procedure. The competencies are built upon a range of Enabling Skills (such as skills and knowledge in Numerical Weather Prediction) and also Transferrable Skills (workplace skills which are not exclusive to meteorology, such as problem-solving and people-management). Each top-level competency is also associated with a range of background knowledge and skills which are essential to the discharge of the defined duties.

1. Analyse and continually monitor the evolving meteorological and/or hydrological situation

1.1 Competency description

Observations and forecasts of meteorological/hydrological parameters and significant meteorological/hydrological phenomena are continuously analysed and monitored to determine the need for issuance, cancellation or amendment/update of forecasts and warnings according to documented thresholds, protocols and regulations.

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1 Personnel engaged in operational forecasting may work across a variety of specializations including aviation, marine and public weather services.

2 For the purpose of forecaster competencies the term PWS forecasters is used to describe forecasters responsible for the preparation and delivery of public weather forecasts and warnings.

3 BIP-M: Basic Instruction Package for Meteorologists

1.2 Performance Criteria

(a) Analyse, interpret and diagnose data and information to identify meteorological/hydrological features pertinent to the area of forecast responsibility;
(b) Monitor meteorological/hydrological parameters and evolving significant meteorological/hydrological phenomena and validate current forecasts and warnings based on these parameters;
(c) Evaluate the need for amendments to forecasts and updates of warnings against documented criteria and thresholds;
(d) Monitor information related to impacts of recent meteorological and hydrological events.

1.3 Background knowledge and skills

(a) Awareness of the importance of meteorological and hydrological services, and an understanding of the effects of forecasts and warnings on users and decision makers, in particular for public safety;
(b) An understanding of the key elements of synoptic, dynamical, and physical meteorology and core analytical/diagnostic skills at least to the level of a BIP-M;
(c) Application of the theory, methods and practices of meteorological and/or hydrological analysis and diagnosis;
(d) An ability to visualize/conceptualize meteorological and/or hydrological information in multiple dimensions (spatial, temporal);
(e) An appreciation of the influence of topography, land cover, and (if relevant) bodies of water and/or snow fields on local meteorology;
(f) Interpretation of in-situ and remote-sensed observations and data;
(g) Understanding of the characteristics of meteorological and/or hydrological sensors and instruments;
(h) Familiarity with the acquisition, processing and assimilation of meteorological and/or hydrological data, including quality control;
(i) Understanding of procedures, standards and technical regulations relating to observations and to forecast and warning products.

2. Forecast meteorological and hydrological phenomena and parameters

2.1 Competency description

Forecasts of meteorological and/or hydrological parameters and phenomena are prepared and issued in accordance with documented requirements, priorities and deadlines.

2.2 Performance Criteria

(a) Forecast meteorological/hydrological phenomena and parameters as required, using appropriate tools and including forecast uncertainties;
(b) Ensure that forecasts are prepared and issued in accordance with national or regional practices, relevant codes and technical regulations on content, accuracy and timeliness;
(c) Ensure, insofar as practicable, that forecasts of meteorological/hydrological parameters and phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility;
(d) Monitor forecasts issued for other regions, and liaise with adjacent regions as required.

2.3 Background knowledge and skills

(a) Core diagnostic and prognostic skills to a BIP-M level;
(b) Knowledge of methods used in Numerical Weather Prediction (NWP) and other forecast applications;
(c) Knowledge of the strengths, limitations and verification outputs of the NWP models used in the forecast office, and of forecast adjustments required to accommodate these;
(d) Knowledge of statistical approaches applicable to meteorological and hydrological information;
(e) Knowledge of probabilistic approaches to forecasting, such as those available through ensemble prediction systems;
(f) Critical comparison of a variety of forecast models, interpretation of observational data and climatological data, and synthesis of this information to make a reasoned estimate of the most likely evolution of the weather, of alternative evolutions, and of the uncertainties associated with each;
(g) Interpretation of model outputs at different time ranges;
(h) Judgement in determining which observational, model, contextual and impact information is most relevant, especially in very short range forecasting;
(i) Knowledge of the potential impacts of meteorological and hydrological events on users and their decision-making processes.

3. Warn of hazardous meteorological and hydrological phenomena

3.1 Competency description

Warnings are issued in a timely manner when hazardous meteorological and/or hydrological conditions are expected to occur, or when parameters are expected to reach documented threshold values or generate significant impacts, and updated or cancelled according to documented warning criteria.

3.2 Performance Criteria

(a) Forecast hazardous meteorological/hydrological phenomena, including spatial extent, onset/cessation, duration, intensity and temporal variations;
(b) Ensure that warnings are prepared and issued in accordance with national protocols for hazardous phenomena and their impacts;
(c) Ensure insofar as practicable, that warnings of hazardous meteorological/hydrological phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility;
(d) Monitor warnings issued for other regions, and liaise with adjacent regions as required;
(e) Maintain awareness of the impacts of hazardous meteorological/hydrological phenomena which are the subject of warnings and notifications.

3.3 Background knowledge and skills

(a) Knowledge of the specific product preparation and dissemination systems used in the forecast office;
(b) Knowledge and skill in using warning production tools;
(c) Knowledge of the policies, procedures and criteria for issuing warnings;
(d) Knowledge of the potential impacts of meteorological and hydrological events on users and their decision-making processes.

4. Communicate meteorological and hydrological information and potential impacts to internal and external users

4.1 Competency description

User requirements are fully understood and are addressed by communicating concise and complete forecasts and warnings in a manner that can be clearly understood by users.

4.2 Performance Criteria

(a) Ensure that all forecast and warnings are disseminated through the authorised communication means and channels to designated user groups as specified in relevant standard operating procedures;
(b) Explain meteorological/hydrological data and information, including uncertainties where required;
(c) Deliver briefings and provide consultation to meet specific user needs as required.

4.3 Background knowledge and skills

(a) Standards, procedures and dissemination methods for the presentation of forecast and warning information to the public across all relevant media, including impact information as required;
(b) Knowledge of protocols for presenting warning information to emergency management partners, including information on likely impacts and mitigation activities if relevant;
(c) An awareness of user's needs for, and use of, meteorological and/or hydrological information;
(d) An awareness of the application of meteorology and hydrology to human activities and specific users.

5. Ensure the quality of meteorological and hydrological information and services

5.1 Competency description

The quality of meteorological and hydrological forecasts, warnings and related products is maintained, through the application of quality management systems processes where appropriate.

5.2 Performance Criteria

(a) Apply the organization's quality management system and procedures;
(b) Validate meteorological and hydrological data, products, forecasts and warnings (timeliness, completeness, accuracy);
(c) Assess the impacts of known error characteristics (bias, achievable accuracy of observations and sensing methods);
(d) Monitor the functioning of operational systems and take contingency actions where appropriate;
(e) Contribute to case studies and post reviews as required, including the assimilation of user feedback and impact information;
(f) Mentor junior colleagues and provide support and advice as required.

5.3 Background knowledge and skills

(a) Knowledge of standard operating procedures and also contingency procedures;
(b) Knowledge of techniques and technology in common use in forecast offices;
(c) Knowledge of validation and verification procedures relevant to meteorological and hydrological forecasts and warnings;
(d) Understanding methods used in developing case studies and feedback to improve the quality of forecasts and warnings.

Competency Requirements for Weather Broadcasters AND COMMUNICATORS

These competency requirements are for personnel who specialize in media work and routinely present weather information on radio or television, prepare material for weather websites and/or social media, conduct media liaison and are active in education/outreach. They build upon, and should be read in conjunction with the fundamental WMO competency requirements for personnel engaged in operational forecasting, although it is recognized that some people engaged in these activities may not come from a forecasting background.

The competency requirements for the work of personnel engaged in weather broadcasting and communication can be divided into four top level competencies. Taking into consideration the conditions (a) to (c) below:

(a) The geographical areas of responsibility;
(b) Meteorological and hydrological impacts on society;
(c) Meteorological and hydrological user requirements, local procedures and priorities.

Weather broadcasters and communicators should be able to perform the work indicated in the top level competencies below:

(a) Maintain awareness of the evolving meteorological and/or hydrological situation, updated forecasts and warnings, and impacts of anticipated conditions;
(b) Assemble meteorological and hydrological information that meet user needs for communication and delivery;
(c) Communicate meteorological and hydrological information and potential impacts via broadcast and other media;
(d) Ensure the quality of meteorological and hydrological information and services.

Each of these top-level competencies is expanded into performance criteria that are expressed and structured in such a manner as to facilitate the clear application of assessment procedures. The competencies are built upon a range of Enabling Skills (such as skills and knowledge in Numerical Weather Prediction) and also Transferrable Skills (workplace skills which are not exclusive to meteorology, such as problem-solving and people-management). Each top-level competency is also associated with a range of background knowledge and skills which are essential to the discharge of the defined duties.

1. Maintain awareness of the evolving meteorological and/or hydrological situation, updated forecasts and warnings, and impacts of anticipated conditions

1.1 Competency description

Observations, forecasts, warnings and impacts of meteorological/hydrological parameters and significant meteorological/hydrological phenomena are continuously monitored to inform the content of weather broadcasts, disseminated products, briefings and other communications.

1.2 Performance Criteria

(a) Monitor meteorological/hydrological parameters and evolving significant meteorological/hydrological phenomena;
(b) Monitor amendments to forecasts and updates of warnings;
(c) Monitor information related to impacts of recent meteorological and hydrological events.

1.3 Background knowledge and skills

(a) An understanding of the key elements of synoptic, dynamical, and physical meteorology;
(b) An appreciation of the influence of topography, land cover, and (if relevant) bodies of water and/or snow fields on local meteorology;
(c) Interpretation of in-situ and remote-sensed observations and data;
(d) Knowledge of the routine dissemination schedule of forecasts and warnings from the meteorological service provider;
(e) Knowledge of the thresholds and protocols associated with the issue of weather warnings by the relevant NMHSs;
(f) Knowledge and understanding of the likely impacts on society of hazardous meteorological and hydrological phenomena.

2. Assemble meteorological and hydrological information that meet user needs for communication and delivery

2.1 Competency description

Observations, forecasts, warnings and impacts of meteorological/hydrological parameters and significant meteorological/hydrological phenomena are assembled and synthesised into coherent narratives and products for dissemination to users.

2.2 Performance Criteria

(a) Articulate the weather story in a manner appropriate to the meteorological/hydrological situation, user expectations and needs;
(b) Articulate the weather story in a manner appropriate to the communications medium employed;
(c) Prepare graphics that visually support the communication of the meteorological/hydrological story and situation;
(d) Apply routine production protocols appropriate to the service provision environment.

2.3 Background knowledge and skills

(a) Knowledge of the range of users / audience who will access the weather communication;
(b) Appreciation of the strengths and weaknesses of the communication medium employed;
(c) Skills in oral and written language as appropriate to the communication medium employed;
(d) Knowledge of, and skills, in the operation of the weather graphics software or other IT facilities used to prepare graphical images and IT related media for the communication of meteorological and hydrological information;
(e) Knowledge of the function and operation of the different technological resources (PCs, servers, mixers, amplifiers, cameras etc.) commonly employed in weather broadcasting, where relevant.

3. Communicate meteorological and hydrological information and potential impacts via broadcast and other media.

3.1 Competency description

Observations, forecasts, warnings and impacts of meteorological/hydrological parameters and significant meteorological/hydrological phenomena are disseminated to users in a manner appropriate to the communications medium and to the needs of users.

3.2 Performance Criteria

(a) Identify the key points in a weather story and/or high impact meteorological/hydrological hazards and develop these into a coherent narrative or presentation;
(b) Explain and communicate the scope and limitations of forecasts and warnings, including the concept of forecast uncertainty, to users;
(c) Present warnings of meteorological and hydrological hazards, including information on possible mitigating actions where appropriate;
(d) Implement the “Single Authoritative Voice” concept in respect to warnings of severe weather and other public safety messages;
(e) Create and deliver presentations on meteorological and hydrological topics to external agencies and to the public;
(f) Deliver meteorological and hydrological information in accordance with broadcast schedules and/or other appropriate media protocols;
(g) Develop and present new graphical representations of meteorological and hydrological information in alignment with editorial policy.

3.3 Background knowledge and skills

(a) Knowledge of the likely impact of upcoming meteorological and hydrological events at different time scales, and skill in judging the relative importance of these;
(b) Knowledge of the likely uncertainty attached to forecasts at different time scales;
(c) Knowledge and understanding of the likely impacts on society of hazardous meteorological and hydrological phenomena;
(d) Knowledge of the policies, procedures and criteria for issuing warnings;
(e) Knowledge of the mitigating actions associated with the likely impacts of hazardous meteorological and hydrological phenomena;
(f) Knowledge of the authoritative sources of meteorological, hydrological, impact and mitigating information relevant to hazardous phenomena;
(g) Skill in the use of presentation and visualisation software to support lectures, seminars and other public engagements;
(h) Knowledge of broadcast schedules, deadlines and other appropriate media protocols.

4. Ensure the quality of meteorological and hydrological information and services

4.1 Competency description

The quality of meteorological and hydrological broadcasts and other communication products is maintained, by the application of approved quality management processes where appropriate.

4.2 Performance Criteria

(a) Apply the organization's quality management system and procedures;
(b) Apply agreed editorial policy to weather broadcasting and other meteorological and hydrological communications;
(c) Ensure, insofar as possible, that all meteorological and hydrological information available to users is consistent, current and up-to-date;
(d) Monitor and assess the effectiveness of the communication of meteorological and hydrological information through user-based metrics;
(e) Develop improvements in the communication of meteorological and hydrological information based on user feedback;
(f) Mentor junior colleagues and provide support and advice as required.

4.3 Background knowledge and skills

(a) Knowledge of standard operating procedures;
(b) Knowledge of contingency procedures appropriate to system failure;
(c) Knowledge of the editorial policy relevant to weather broadcasting and other meteorological and hydrological communications;
(d) Knowledge of techniques and technology commonly used in the dissemination of meteorological and hydrological information;
(e) Knowledge of the various user-based metrics relevant to the assessment of the effectiveness of communication of meteorological and hydrological information.

Competency Requirements for Persons Engaged in the DEVELOPMENT AND DELIVERY of Meteorological and hydrological Products and Services

These competency requirements are primarily aimed at personnel who are engaged in the area of innovation, improvement, and delivery of meteorological and hydrological services and products. They should be read in conjunction with the competency requirements for personnel engaged in operational forecasting, although it is recognized that many people engaged in these aspects of work may not come from a forecasting background.

These competency requirements are divided into four top level competencies. Taking into consideration the conditions (a) to (c) below:

(a) The nationally-defined PWS areas of responsibility;
(b) Meteorological and hydrological impacts on society;
(c) Meteorological and hydrological user requirements, local procedures and priorities.

Persons engaged in the development and delivery of meteorological and hydrological products and service should be competent to perform the tasks defined through the four top level competencies, as follows:

(1) Maintain awareness of developments in technology, and science which facilitate the development and improvement of products and services to meet user requirements;
(2) Develop applications, products and services that meet user requirements;
(3) Develop and manage relationships with users and other stakeholders, in particular through providing documentation and delivering training on new products and services;
(4) Ensure the quality of meteorological and hydrological information and services.

Each of these top-level competencies is expanded into performance criteria that are expressed and structured in such a manner as to facilitate the clear application of an assessment procedure. The competencies are built upon a range of Enabling Skills (such as skills and knowledge in Numerical Weather Prediction) and also Transferrable Skills (workplace skills which are not exclusive to meteorology, such as problem-solving and people-management). Each top-level competency is also associated with a range of background knowledge and skills which are essential to the discharge of the defined duties.

1. Maintain awareness of developments in technology and science which facilitate the development and improvement of services and products to meet user requirements.

1.1 Competency description

The needs of users for products based on meteorological and hydrological information is monitored, as are the available technologies and techniques relevant to the development of products and services and their dissemination.

1.2 Performance Criteria

(a) Maintain awareness of users' current and future requirements for meteorological and hydrological products and services;
(b) Maintain awareness of scientific developments supporting the development and improvement of meteorological and hydrological products and services;
(c) Maintain awareness of developments in communication and information technologies, standards and protocols relevant to the creation and dissemination of meteorological and hydrological products and services.

1.3 Background knowledge and skills

(a) An understanding of the key elements of synoptic, dynamical, and physical meteorology;
(b) Knowledge of the range of available in-situ and remote-sensed observations and data;
(c) Knowledge of meteorological and hydrological information available through Numerical Weather Prediction, statistical outputs and other appropriate sources, and of their potential value for users;
(d) Knowledge of the relevant technologies available for the development of products based on meteorological and hydrological information, and their dissemination.

2. Develop applications, products and services that meet user requirements.

2.1 Competency description

Products and services based on meteorological and hydrological information are developed and improved in line with the needs of users and the capabilities of the available technologies and techniques.

2.2 Performance Criteria

(a) Develop, test and implement applications and products, including relevant uncertainties, in support of user-focused services;
(b) Develop applications for the visualization and display of meteorological and hydrological information, including forecast uncertainty;
(c) Optimise systems used to produce and disseminate meteorological and hydrological products and services;
(d) Implement changes to applications, products and services consequent on evolving user needs and/or changing technologies;
(e) Document applications and products and their implementation processes to aid users and support maintenance and continuity of service.

2.3 Background knowledge and skills

(a) Knowledge of the range of users / audience who will access the meteorological and hydrological products, and of their requirements;
(b) Knowledge of statistical methods and techniques commonly used in processing and visualising meteorological and hydrological information;
(c) Knowledge of the characteristics and capabilities of visualisation and display systems used for meteorological and hydrological information;
(d) Knowledge of probabilistic approaches to forecasting and representation (including especially graphical representation) of uncertainty in forecast products, such as those based on ensemble systems;
(e) Knowledge of the characteristics and capabilities of the dissemination media employed;
(f) Knowledge of and skill in the operation of IT facilities used to prepare graphical images for the communication of meteorological and hydrological information;
(g) Knowledge of procedures for documenting and keeping record of software applications development.

3. Develop and manage relationships with users and other stakeholders, in particular through providing documentation and delivering training on new products and services.

3.1 Competency description

Relationships with users are developed and maintained to support the ready identification of user needs and requirements and changes to these over time. Relationships with users are formalised through appropriate agreements where necessary.

3.2 Performance Criteria

(a) Participate in the assessment of the needs of users, in collaboration with relevant experts;
(b) Establish and maintain working relationships at operational and technical levels with users and other stakeholders;
(c) Develop partnership agreements at operational and technical levels with users and other stakeholders;
(d) Develop and make available adequate background documentation on new products and services;
(e) Develop and deliver training to users and stakeholders on products and services as required.

3.3 Background knowledge and skills

(a) Knowledge of the methodologies for the understanding and development of user requirements;
(b) Knowledge of the methodologies for the development of partnerships, memoranda of understanding, service level agreements etc. with users of meteorological and hydrological information and products;
(c) Understanding of the operational systems and working priorities of relevant users;
(d) Knowledge of the training methods and techniques appropriate to users and other stakeholders;
(e) Understanding of the vulnerabilities of various users and how these may be impacted by meteorological and hydrological events.

4. Ensure the quality of meteorological and hydrological information and services

4.1 Competency description

The quality of products and services based on meteorological and hydrological information is maintained, through the application of quality management systems processes where appropriate.

4.2 Performance Criteria

(a) Apply the organization's quality management system and procedures;
(b) Support the implementation and ongoing validation of automated meteorological and hydrological products and services;
(c) Support training in the access, use and interpretation of products and applications related to meteorological and hydrological services.

4.3 Background knowledge and skills

(a) Knowledge of standard operating procedures;
(b) Knowledge of contingency procedures appropriate to system failure;
(c) Knowledge of techniques and technology commonly used in the dissemination of meteorological and hydrological information;
(d) Knowledge of the various user-based metrics relevant to the accessibility and understanding of meteorological and hydrological information through products and applications;
(e) Knowledge of procedures for documenting and keeping record of software applications development;
(f) Knowledge of appropriate methods and techniques for user training.

Competency Requirements for PWS ADVISORS SUPPORTING Disaster Prevention and Mitigation AND OTHER USER ACTIVITIES

These competency requirements are for PWS advisors who work in the area of Disaster Prevention and Mitigation (DPM) and engagement with the Emergency Management (EM) community and other relevant users (such as those involved in health, transportation, energy, food safety). They build upon, and should be read in conjunction with, the fundamental WMO competency requirements for personnel engaged in operational forecasting, although it is recognized that some people engaged in liaison and outreach in EM may not come from a forecasting background. In such cases, the PWS Advisor needs to work closely with operational forecasters to develop the products and services indicated in the following sections, taking into consideration the conditions (a) to (c) below:

(a) The nationally-defined PWS areas of responsibility;
(b) Meteorological and hydrological impacts on society;
(c) Meteorological and hydrological societal requirements, local procedures and priorities.

A PWS Advisor should be able to perform the work (in close association with the PWS forecaster if need be) indicated by the five top level competencies below:

(1) Monitor continually the evolving meteorological and/or hydrological situation, updated forecasts and warnings, and impacts of anticipated conditions;
(2) Develop and adopt procedures and services to meet user needs and facilitate impact assessments;
(3) Develop and manage relationships with DPM users and other stakeholders;
(4) Communicate meteorological and/or hydrological information and potential impacts to internal and external users and engage in outreach activities;
(5) Ensure the quality of meteorological and hydrological information and services.

Each of these top-level competencies is expanded into performance criteria that are expressed and structured in such a manner as to facilitate the clear application of an assessment procedure. The competencies are built upon a range of Enabling Skills (such as skills and knowledge in Numerical Weather Prediction) and also Transferrable Skills (workplace skills which are not exclusive to meteorology, such as problem-solving and people-management). Each top-level competency is also associated with a range of background knowledge and skills which are essential to the discharge of the defined duties.

1. Monitor continually the evolving meteorological and/or hydrological situation, updated forecasts and warnings, and impacts of anticipated conditions.

1.1 Competency description

Observations and forecasts of meteorological/hydrological parameters and significant meteorological/hydrological phenomena are continuously analysed and monitored, together with amendments/updates of forecasts and warnings, and assessments of the likely impacts of anticipated conditions are developed and updated as required.

1.2 Performance Criteria

(a) Monitor meteorological/hydrological parameters and evolving significant meteorological/hydrological phenomena, and validate current forecast and warnings based on these parameters;
(b) Monitor information relating to impacts of meteorological and hydrological events.

1.3 Background knowledge and skills

(a) An understanding of the key elements of synoptic, dynamical, and physical meteorology and core analytical/diagnostic skills;
(b) Application of the theory, methods and practices of meteorological and/or hydrological analysis and diagnosis;
(c) The ability to visualize/conceptualize meteorological and/or hydrological information in multiple dimensions (spatial, temporal);
(d) The appreciation of the influence of topography, land cover, and (if relevant) bodies of water and/or snow fields on local meteorology;
(e) Interpretation of in-situ and remote-sensed observations and data;
(f) Understanding of the characteristics of meteorological and hydrological sensors and instruments;
(g) Familiarity with the acquisition, processing and assimilation of meteorological and hydrological data, including quality control;
(h) Understanding of procedures, standards and technical regulations regarding observations and forecast products;
(i) Understanding of sector specific activities and vulnerabilities impacted by meteorological and hydrological events.

2. Develop procedures and services to meet user needs and facilitate impact assessments.

2.1 Competency description

Procedures and services which facilitate impact assessment based on meteorological and hydrological information are developed and improved in line with the needs of users, making full use of impact modelling and other techniques where these are available

2.2 Performance Criteria

(a) Identify the meteorological and/or hydrological information requirements of the disaster management and civil protection community, and other users as required;
(b) Tailor weather warning services for emergency management decision-makers and other users;
(c) Ensure that warning dissemination schedules and related services meet the decision-making needs of emergency managers and other users;
(d) Contribute to the development of very short-range forecasting and nowcasting services tailored to the emergency management community;
(e) Contribute to the development of probabilistic forecast products tailored to the needs of disaster managers and other users;
(f) Contribute to the development of impact-based forecast and warning products;

(g) Apply new technology and scientific research in contributing to the development of Multi-Hazard Early Warning Systems (MHEWS).

2.3 Background knowledge and skills

(a) Knowledge of meteorological and hydrological information, products and services available to support disaster management, the civil protection community and other users;
(b) Knowledge of the methodologies for the understanding and development of user requirements;
(c) Knowledge of risk assessments and how they apply to various sectors;
(d) An understanding of how meteorological and hydrological risks may have an impact of various sectors as a function of vulnerability and exposure factors;
(e) Skill in adapting usual meteorological and hydrological products and services into value-added services for disaster management and other users;
(f) Knowledge of the strengths and limitations of NWP models;
(g) Knowledge of developments and innovations in Numerical Weather Prediction and how these may apply to meteorological and hydrological impact-based services.

3. Develop and manage relationships with DPM users and other stakeholders.

3.1 Competency description

Relationships with users in the Emergency Management and related communities are developed and maintained to support the ready identification of user needs and requirements and changes to these over time. Relationships with users are formalised through appropriate agreements where necessary.

3.2 Performance Criteria

(a) Establish and maintain working relationships at strategic, operational and technical levels with the emergency management community;
(b) Develop and implement partnership agreements at operational and technical levels with relevant agencies;
(c) Build and maintain relationships with the media to facilitate communication of warnings and information prior to, during and after high impact meteorological and hydrological events;
(d) Build and maintain relationships between the NMHS and relevant agencies to improve emergency planning, preparedness, and response to high impact meteorological and hydrological events, including specific urban needs where appropriate;
(e) Contribute to the development of response advice and call-to-action statements based on the potential impact of hazards, in close coordination with relevant agencies as appropriate;
(f) Participate in the assessment of the socio-economic impact of meteorological and hydrological events, in collaboration with relevant experts.

3.3 Background knowledge and skills

(a) Knowledge of the methodologies for the development of partnerships and memoranda of understanding;
(b) Knowledge of meteorological and hydrological information, products and services available to support disaster management, the civil protection community and other users;
(c) Understanding of the priorities and operational systems of relevant agencies;
(d) Understanding of the principles of communication relating to the development of advice and statements addressing potential impacts of hazards;
(e) Understanding of the vulnerabilities of various sectors and how these may be impacted by meteorological and hydrological events.

4. Communicate meteorological and hydrological information and potential impacts to internal and external users and engage in outreach activities.

4.1 Competency description

User requirements are fully understood and are addressed by communicating concise and relevant meteorological information and impact assessments in a manner that can be clearly understood by users. Preparedness of user communities is addressed through training and other outreach initiatives

4.2 Performance Criteria

(a) Contribute to dissemination of warning information through utilization of current and emerging communication technologies;
(b) Communicate meteorological and hydrological information to users, in particular disaster management decision-makers and media, including the scope and limitations of forecasts and warnings, the concept of forecast uncertainty, and information on potential impacts;
(c) Contribute to the development of a communication strategy to ensure credibility of, and effective response to, warnings of high impact meteorological and hydrological events;
(d) Promote community awareness and preparedness for high impact meteorological and hydrological events through public education and outreach.

4.3 Background knowledge and skills

(a) Knowledge of protocols for presenting and communicating warning information to emergency management partners and media, including information on likely impacts and mitigation activities if relevant;
(b) Knowledge of standards, procedures and dissemination platforms for the presentation of forecast and warning information to end users across all relevant media, including impact information as required;
(c) Knowledge of the authoritative sources of meteorological, hydrological, impact and mitigating information relevant to hazardous phenomena;
(d) An awareness of the application of meteorology and/or hydrology to human activities and to specific users;
(e) An awareness of user's needs for, and use of, meteorological and/or hydrological information;
(f) Awareness of social science research and findings relevant to the communication of warnings and impact-based meteorological and/or hydrological information;
(g) An appreciation of the strengths and weaknesses of the communication media employed.

5. Ensure the quality of information, services and procedures.

5.1 Competency description

The quality of meteorological and hydrological forecasts, warnings, impact assessments, and related products is maintained, through the application of quality management systems processes where appropriate.

5.2 Performance Criteria

(a) Apply the organization's quality management system and procedures;
(b) Monitor and assess the effectiveness of warnings of high impact meteorological and hydrological events through user-based feedback;
(c) Work with disaster management agencies and others to strengthen the role of NMHSs as the “Single Authoritative Voice” for warnings of high impact meteorological and hydrological events;
(d) Contribute to the development of documentation and archiving systems for meteorological and hydrological hazard and impact data, including quality assurance and data management;
(e) Collaborate with disaster management agencies and others in the development of post-events assessments of high impact meteorological and hydrological events;
(f) Contribute to outreach and training initiatives particularly those relevant to DPM activities.

5.3 Background knowledge and skills

(a) Knowledge of quality management system processes;
(b) Knowledge of methodologies for the creation, delivery and assessment of user-feedback surveys;
(c) Knowledge of documentation and archiving systems protocols;
(d) Knowledge of verification processes;
(e) Knowledge of operating and contingency procedures of NMHS and relevant agencies;
(f) Understanding metrics and methods used in developing post assessments/case studies and verification.
