CARIBBEAN METEOROLOGICAL ORGANIZATION

ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES   **Doc. 4**
PORT OF SPAIN, TRINIDAD AND TOBAGO, 15 NOVEMBER 2023

OPERATIONAL MATTERS
(Submitted by the Coordinating Director)

INTRODUCTION

1.   Over the last year, National Meteorological and Hydrological Services (NMHS) of the Caribbean Meteorological Organization (CMO) Member States have slowly closed operational gaps and built capacity and capability in the implementation of some of the *World Meteorological Organization* (WMO) priority programmes. This includes strengthening observations and data exchange processes to increase support for global numerical weather prediction and early warning systems for weather, water, and climate hazards.

2.   Several matters that are particularly related to and impact operations at NMHSs are highlighted or addressed in this document, either to:
  • Raise awareness on matters that remain outstanding, and are of immediate concern, and require action by the NMHSs; or
  • Create awareness of ongoing or upcoming issues that will impact operational services in the near future.

A. GLOBAL BASIC OBSERVING NETWORK (GBON)

3.   The Meeting will recall the discussion at the Annual Meeting of Directors of Meteorological Services 2022 (DMS2022) on the implementation of the *Global Basic Observing Network* (GBON) (Resolution 2 (Cg-Ext (2021))), effective on 1 January 2023. GBON implementation was endorsed at Congress 19 (Cg19). Since the in-person WMO regional training workshop in February 2023 in Jamaica and subsequent online training workshops, more CMO Member States have registered GBON stations in OSCAR/Surface and shared observation data globally at an hourly frequency.

4.   At the time of writing this document, the number of CMO Members with GBON stations registered in OSCAR/Surface has **increased from seven (7) members (44% of CMO) at DMS2022 to sixteen (16) currently (100% of CMO)**. At the same time, the number of CMO Member stations **exchanging data at hourly frequency has increased from two (2) stations from one (1) Member at DMS2022 to eleven (11) stations from eight (8) Members currently**, which is a relatively large increase, but still only 50% of the 22 GBON stations registered by CMO Members. Directors are reminded that GBON requires Members to commit and ensure that their surface and upper air observations are exchanged in real time at hourly time frequencies through the WMO Global Telecommunication System and WMO Information System in BUFR format.

5.   Anguilla, Belize, the British Virgin Islands, Dominica, Jamaica, Montserrat, and Saint Lucia have registered GBON stations with schedules for hourly exchange of observations internationally; however, in these Members existing operational practice, SYNOP observations from GBON stations are only exchanged only every 3 hours, which is non-compliant with GBON.

6.   GBON compliance is particularly important because it is directly linked to the Systematic Observations Financing Facility (SOFF), whose purpose to provide technical and financial support to the implementation and operation of GBON. SOFF will apply compliance with GBON requirements to guide further investments, using international data exchange as a measure of success.

7.   WMO requires its Members to routinely monitor their GBON stations performance across the network to identify non-conformity with the designed performance. GBON compliance is being monitored using data from the **WIGOS Data Quality Monitoring System (WDQMS)** webtool. Stations registered in OSCAR/Surface with GBON affiliation are monitored for availability, timeliness, and quality compliance at both station and member scales. The full set of GBON provisions and regulations is specified in the **Manual on the WMO Integrated Global Observing System (WMO-No. 1160)**, Section 3.2.2, and Appendix 3.1.

B. WMO INTEGRATED GLOBAL OBSERVING SYSTEM (WIGOS) MATTERS

8.   In the *WMO Integrated Global Observing System* (WIGOS) operational plan for 2020–2023, Members' NMHSs are supposed to engage in a number of activities, including nominating National Focal Points for OSCAR/Surface, WIGOS, and WDQMS. Each Members is to implement a national WIGOS Station Identifiers (WSI) system and develop a national WIGOS Implementation Plan, including establishing national processes for acting on issues and incidents received.

WIGOS Operational Plan On-Track Among CMO Members NMHSs

9.   At DMS2022, Directors were provided with a status report on WIGOS implementation across CMO Member States, based on a survey disseminated by CMO Headquarters. Since then, the majority of Members NMHSs have either partly or fully implemented national WIGOS activities.

10.   These efforts, supported by CMO Headquarters, yielded key outcomes and deliverables that are consistent with WMO RA IV regional priorities and the CMO Headquarters strategic goal to advance regional and national WIGOS implementation. Particularly, the CMO Members made considerable improvements in the number of NMHSs with functional WIGOS-related National Focal Points (NFP). The majority now have trained NFPs for WIGOS, WDQMS, and OSCAR/Surface.

11.   Improvement in the national and regional implementation of WIGOS is also noticeable by the relatively large increase in CMO Member NMHSs with stations coloured green on the WDQMS Near-real-time NWP monitoring of the Global Observing System networks compared to the situation at DMS2022. The number of WIGOS stations from CMO Members coloured green on the WDQMS Near-real-time NWP webtool is currently fifteen (15) stations, up from three (3) stations during DMS2022. This means that 63% of the 24 stations from CMO Member States, that are

registered in OSCAR/Surface to exchange data internationally, are successfully providing critical input to regional and global weather prediction and climate analysis needed for early warning, disaster preparedness, and climate adaptation.

12.   Directors are asked to note that despite the successes, there are still outstanding WIGOS gaps to be closed. At the time of writing this document, only two (2) NMHSs have fully or partially implemented new National WIGOS Station Identifier (WSI) systems and National WIGOS Implementation Plans. This has implications for SOFF if not implemented, since no new GBON station can be registered in OSCAR/Surface without a national WSI.

Table 1.0 Examples of National WSI for two CMO Member States

Block (content type)	1st block (number)	2nd block (number)	3rd block (number)	4th block (character)
Description/Name	WIGOS Identifier Series (number)	Issuer of Identifier (number)	Issue Number (number)	Local Identifier (characters)
Examples				
Barbados station (Grantley Adams) 0-52-130-78954	0	52	130	78954
Barbados station (Homes St Phillips 3D PAW) 0-52-130-0057	0	52	130	00057
Jamaica station (Mitchell Town) 0-388-7-78397	0	388	7	78397
Jamaica station (Shettlewood) 0-388-18-78397	0	388	18	78397

13.   CMO Members NMHSs are on track and can achieve most of the components of the WIGOS operational plan by the end of 2023. In this regard, Directors are reminded of the following key activities for WIGOS implementation:
- Establish a National WIGOS Station Identifiers System for registering observing stations in their area of observing responsibility on the OSCAR/Surface database, using the format stipulated in the Guide to the WMO Integrated Global Observing System (WMO 1165), https://library.wmo.int/records/item/55696-guide-to-the-wmo-integrated-global-observing-system,WMO Technical Regulations (WMO-No. 49)-Regulatory Material, and Manual on WIGOS (WMO-No.1160) - Regulatory Material.
- National WIGOS Station Identifiers cannot be represented in the traditional alphanumeric code forms, such as FM-12 SYNOP. Only table-driven code-form equivalents such as FM-94 BUFR can represent the new WSI and must be used to exchange observations from stations with new WSIs.
- Establish National WIGOS implementation plans.

C. REGIONAL WIGOS CENTRE

14.   As part of WIGOS implementation, each WMO Regional Associations (RA) is required to operationalize a Regional WIGOS Center (RWC), one of the six main priorities for WIGOS implementation. The purpose of the RWC is to provide support and assistance to WMO Members,

perform data quality evaluation and incident management functions using the WDQMS Webtool and Incident Management System (IMS) at daily time scales.

15.   Directors will recall the Concept of Operations for the RA IV RWC that was approved by the RA IV Management Group. Following the endorsement of the implementation plan for the RWC by the Management Group, a hybrid training workshop organized and delivered by the WMO Secretariat on WDQMS and IMS for RWC staff and WDQMS-NFPs was held during the RA IV RECO in Jamaica, 6-9 February 2023. Subsequently, RA IV Management Group endorsed the kick-off of the RWC operations in pilot mode as a distributed system; set to be operationalized later this year.

16.   The approved structure of the RWC in operational mode consists of Leading Nodes and Contributing sub-nodes performing distributed functions for metadata management and quality monitoring, including monitoring, evaluation, and incident management functions to cover all RA IV Members. The approved nodes and sub-nodes of RA IV RWC are as follows:

- **Canada (Ln/Canada)**: Leading Node (Ln) for Metadata Management
- **USA (Ln/USA)**: Leading Node (Ln) for Quality Monitoring
- **Costa Rica** (Cn/Costa Rica): Contributing Node (Cn) for Spanish-speaking countries for both metadata management and quality monitoring
- **Trinidad & Tobago (T&T)** (Cn/T&T): Contributing Node (Cn) for English-speaking countries for metadata management
- **British Caribbean Territories/Caribbean Meteorological Organization Headquarters (BCT/CMO HQ)** (Cn/BCT-CMO): Contributing Node (Cn) for English-speaking countries for quality monitoring

17.   During operations of the RWC, all issues for quality monitoring and metadata management will be recorded in the WMO Incident Management System (IMS) through creation of either issue-tickets or incident-tickets for the issues raised. The main steps and tasks for the leading and contributing nodes of the RWC for both metadata management and quality monitoring functions are described in ANNEX I: REGIONAL WIGOS CENTRE.

18.   Engagement of all WIGOS-related NFPs by the relevant Ln and Cn will be crucial for the successful operations of the RWC. To facilitate successful engagement, all Members must have active NFPs for WIGOS, OSCAR/Surface, and WDQMS to interact with the RWC. Directors are asked to act on the following:

- Take note of the actions required by the WDQMS NFP and act decisively when an incident is escalated by the RWC.
- Nominate or update their NFPs for WIGOS, OSCAR/Surface, and WDQMS

D. WMO INFORMATION SYSTEM (WIS) 2.0

19.   During Cg-19 in May 2023, WMO approved the Technical Regulations of the WMO Information System 2.0 (WIS2.0), (WMO-No.1060). WIS2.0 is meant to replace the Global Telecommunication System (GTS), support Resolution 1 (Cg-Ext (2021)) - WMO Unified Policy for the International Exchange of Earth System Data) and support the establishment of GBON. WIS2.0, which is an internet-based service, is currently up and running in a one-year pilot phase

to be completed at the end of 2023, with a pre-operational phase scheduled for 2024. This will be followed by a transition phase starting in 2025. Several WMO Members have already started implementing WIS2.0 to share real-time data.

Understanding WIS2.0

20.   The main components of the WIS2.0 are:

- WIS2.0 node (data publisher)
- WIS2.0 Global Broker
- WIS2.0 Global Cache
- WIS2.0 Global Discovery Catalogue
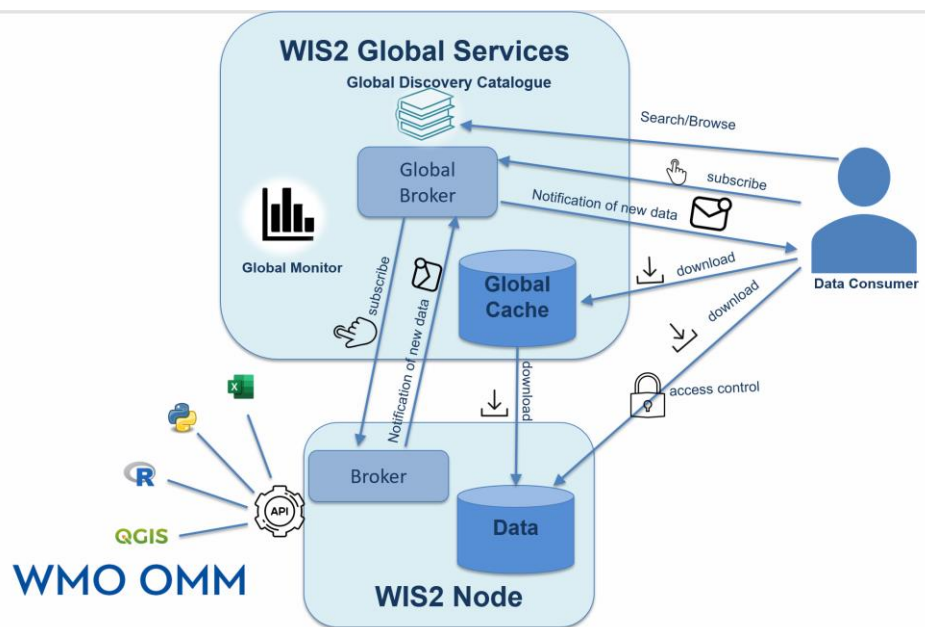- WIS2.0 Global Monitoring

Figure 1.0 WIS 2.0 Concept Main Components and Data Flow

21.   Central to WIS 2.0 are WIS2 Nodes. These are used by National Centres (NC) and Data Collection and Production Centres (DCPC) publishing their Core and Recommended Data. In practical terms, the WIS2.0 nodes (data publishers) manage, organize, and provide access to one or more datasets such as observations in SYNOP or BUFR formats.

22.   For each dataset, a publisher provides:

- Discovery metadata
- An API (application programming interfaces) end point or web service to access (or interact with) the dataset
- Notification messages to advertise the availability of new data and metadata.

23.   The WIS2.0 Global Broker(s) acts as a mediator by providing a high-availability messaging service. The global brokers subscribe to the WIS2 nodes to receive updates when new data and metadata become available. These messages are then republished to the subscribed Global

Caches, who in turn download and cache the data. Once cached, the Global Caches publish a notification that the data is ready for access, with the notifications routed to users via the Global Brokers.

24.   The WIS2.0 Global Cache(s), likewise, provide a high-availability data caching and download service. On receipt of a message from a Global Broker, the Global Cache will download a copy of the data via the publisher's web service or API. Access to the cached data is then made available to users via high-availability and high-bandwidth services.

25.   The WIS2.0 Global Discovery Catalogue(s) maintain and make available searchable catalogues of all the WIS2.0 discovery metadata for the datasets made available by the publishers. This includes the facility to manually search and download data using the catalogue as well as the facility to automate the task and use machine-based software agents. Catalogue entries include links to subscription-based services as well as to links to datasets for non-real-time access.

WIS2 in a Box Software

26.   WMO   has   developed   the   open-source   software   "**WIS2   in   a   Box**" (https://docs.wis2box.wis.wmo.int) to support Small Island Developing States (SIDS) and Least Developed Countries (LDCs) with implementing WIS 2.0. WIS2 in a Box, which has plug-and-play capability for supporting data publishing, discovery, and access, provides a platform for National Meteorological Centres to integrate their data and publish it to the WIS.

27.   NMHSs using WIS2 in a Box will be able to access data in real-time by subscribing to a Global Broker and receiving notifications when new data is available for download from a Global Cache or from the data provider. They will also access data directly through Web APIs, connecting their software (or their browser) and processing or visualizing data of their interest (live demonstration can be found at https://demo.wis2box.wis.wmo.int).

WIS2 in a Box Implementation in CMO Member States

28.   Implementing WIS2 to exchange data requires a WMO Member to establish a WIS2 node. Directors will recall the DMS2022 discussion on the WIS2.0 implementation plan, including building CMO Member States capacity to exchange data in BUFR format, using a tailored approach in the implementation of the WIS2 Box that satisfies national and regional needs.

29. In response to those discussions, CMO Headquarters, in collaboration with WMO, hosted a WIS 2.0 training workshop that focused on using the WIS2Box to solve Members data transmission issues and increase Members capacity, understanding, and commitment to the transition to WIS2.0. Since WIS2.0 implementation require a web-accessible resource, typically an HTTP(s) server, exposing the data internationally (a public-facing server) shared to the WIS2 network, which could be challenging for some CMO Members NMHSs, it was decided that workshop participants would continue to work as a team following the workshop, following a regional approach. The team, led by Belize, worked on completing the following action items by October 2023:

- Implement a regional WIS2box as a WIS2 node to facilitate multi-country data exchange as a project and use it to exchange hourly data from observation stations (automatic weather stations and manual stations).
- Able to exchange manual observations in BUFR format via the regional WIS2 node using a SYNOP to BUFR conversion template that allows manual data entry of observations, in line with the current mode of operations at most CMO Member State NMHSs.
- Members who have the capacity and resources would implement and manage their own WIS2box as a national WIS2 node.

30.   In order to facilitate the implementation of the regional WIS2Box, CMO HQ signed a letter of agreement with the WMO to host a WIS2Box as a Caribbean WIS2 node via a cloud server provided by the WMO. Under the agreement, WMO will support CMO and its Members in implementing and operating the WIS2 node for four years, and the Caribbean WIS2 node must hosts at all times, at least five (5) members exchanging data via WIS2.

In return, each participating Member on the Caribbean WIS2 node must agree to:

- Participate in the shared CMO WIS2 node implementation and operation.
- Cooperate and commit resources – at least one (1) staff member to act as a WIS2 administrator/ focal point to assist with configuring the WIS2Box software, work with other Member States to prepare and submit configuration files, and perform in-country WIS2 duties, including troubleshooting, and intervening when there are WIS2 issues to be resolved as it relates to the Member.

31.   The Caribbean WIS2 Node is up and running and forms part of the 36 countries in the WIS2Box demonstration project. At the time of writing this document, the following eleven (11) Caribbean NMHSs are currently on the Caribbean node, which can be found at the **Caribbean WIS2 Node: Antigua and Barbuda, Cayman Islands, Dominica, Grenada, St Kitts and Nevis, Guyana, Jamaica, Saint Lucia, St Maarten, St Vincent and the Grenadines, Turks and Caicos Islands.** Two members, **Belize** and **Trinidad and Tobago** have implemented individual WIS2Box nodes and are also part of the demonstration project. The Members surface stations are now available on one of the global brokers that provide surface stations receiving observations from decoded BUFR messages over the past 24 hours. The global broker depicting this can be found at **http://wis2live.meteo.fr/.**

E. PROGRESS IN ICAO METEOROLOGICAL INFORMATION EXCHANGE MODEL (IWXXM)

32.   The implementation of meteorological information exchange in digital form - ICAO Meteorological (Weather) Information Exchange (in XML) Model (IWXXM) format by CMO Members NMHSs for the dissemination of aeronautical meteorological information have not progressed over the last year.

33.   Directors will recall the discussion at DMS2022 on ICAO/WMO's announcement that IWXXM was now a Standard in ICAO Annex 3—Meteorological Service for International Air Navigation. This Standard specifies that Members should disseminate METAR, SPECI, TAF, SIGMET, AIRMET, Volcanic Ash Advisory, and tropical Cyclone Advisory in IWXXM format.

34.   ICAO plans to remove the Traditional Alphanumerical Characters (TAC) format as a Standard in ICAO Annex 3 with production of the IWXXM at source being strongly encouraged

(rather than translation from Traditional Alphanumerical Characters (TAC) to IWXXM). ICAO has indicated that the dissemination of meteorological information in TAC format will change from a Standard to a Recommended Practice in 2024, then from 2026, will no longer be included in ICAO.

35. Directors are also asked to recall the CMO HQ survey among Members that was shown at DMS2022. Those results showed that only one (1) of the sixteen (16) Members was disseminating aeronautical meteorological information using IWXXM at source. This has changed marginally, with both Guyana and Trinidad and Tobago joining Barbados in this regard. ICAO by State letter, Ref.: AN 10/1-23/1 dated 26 January 2023 served notice that it plans to further amend Annex 3 and Members were supposed to provide comment on the proposed amendments by 26 July 2023.

36.   The proposed amendments address *inter alia*, increased usage of IWXXM to exchange meteorological information. The proposed amendments are to take effect from 28 November 2024. Members are therefore urged to complete the process of implementing tools for the exchange of aeronautical meteorological messages in IWXXM format.

F. DISCONTINUATION OF WMO-NO. 49, VOLUME II

37.   A two-stage plan of action for the discontinuation of WMO-No. 49, Volume II Meteorological Service for International Air Navigation, was approved at Cg-19 via Resolution 12 (Cg-19):
Stage 1: Discontinuation of (1) Part I, International Standards and Recommended Practices: Core Standards and Recommended Practices; and Part II, International Standards and Recommended Practices: Appendices and Attachments of WMO-No. 49, Volume II on 31 December 2023.
Stage 2: Discontinuation of Part III, Aeronautical Climatology and Part IV, Format and Preparation of Flight Documentation upon the applicability of an amendment to ICAO Procedures for Air Navigation Services — Meteorology (PANS-MET) (Doc 10157) (provisionally 2026).

38.   On 22 September 2023, WMO Secretariat notified Members of the discontinuation of WMO-No. 49, Volume II and, reminded and urged Members with responsibility to provide aeronautical meteorological services to gain free, online access to Annex 3 to the Convention on International Civil Aviation, Meteorological Service for International Air Navigation and, when available, the PANS-MET (Doc 10157) via the electronic library (https://elibrary.icao.int/).

G. IMPLEMENTATION OF A QUALITY MANAGEMENT SYSTEM (QMS) FOR AIR NAVIGATION

39.   It has been ten (10) years since the WMO and ICAO Standard, which require all NMHSs to establish and implement a properly organized quality system to provide for the quality management of the meteorological information supplied to aviation users, came into force. Directors will recall the lengthy discussion at DMS2022 on the status of QMS implementation among CMO Member States NMHSs. The discussion also reflected a growing concern of regional NHMSs being audited by regional and national meteorological authorities in relation to QMS implementation.

40.   The meeting agreed that the CMO Headquarters should engage a program of actions that will lead to a regional project, to foster capacity development and resource mobilization, to ensure that all Members advance QMS implementation and certification in the shortest possible time. This program of actions included conducting a baseline assessment of the status QMS implementation in CMO Member States agencies providing meteorological services for air navigation.

41.   The CMO HQ conducted a baseline assessment and the results revealed (Table 2.0) that the majority of CMO's Member States' agencies providing meteorological services for international air navigation, have fully or partially implemented an operational Quality Management System or activities related to implementing a QMS. Only one (1) CMO Member has indicated that it made no attempt at implementing QMS.

42.   Eleven (11) Members have developed QMS quality manuals or have standard forms, work instructions, and Standard Operating Procedures (SOP) to some degree for the provision of meteorological services for air navigation, while six (6) Members have Certified QMS Auditors performing QMS duties. However, nine (9) Members indicated that they have no trained personnel to perform calibration or possess calibration equipment to perform calibration duties.

43.   Notably, seven (7) Members indicated that a QMS was implemented, which conforms to ISO 9001 series standards. Three (3) of these Members implemented the recommended ISO 9001:2015 standards, which replaced the previous version, ISO 9001:2008. However, another four Members that had implemented ISO 9001:2008 have not yet made the transition to the new standard.

44.   At the time of this assessment, none of the established QMS had been certified. It should be noted that while certification is a recommendation, it is not mandatory but is encouraged by the WMO and ICAO. The WMO guide indicated that certification of compliance with the ISO 9001 standard will attain international credibility when an independent (third-party) certification body that can substantiate the claim through an audit has been used. Thus, certification via an audit is a powerful way to demonstrate conformity with the quality system requirement.

Table 2.0   QMS Baseline Results

QMS Status Implementation Indicator	Number of Members	Notes
Members with QMS established and certified	Nil	No Member has ISO 9001:2015 QMS certification. QMS Certification is a recommendation, is desirable, but not mandatory.
Members with QMS established but not certified	7	**3** Members implemented – ISO 9001:2015: **Antigua & Barbuda, Barbados, St Vincent & the Grenadines**
		1 Member is currently implementing the 9001:2015 standard and is expected to apply for certification before the end of 2023. **Guyana**
		4 Members implemented – ISO 9001:2008 :**Jamaica, Guyana, St Kitts & Nevis, Trinidad & Tobago**

Members with no attempt at implementing QMS for aviation meteorological services	1	**1** Member made no attempt at implementing QMS. This member has no human capacity available. **Anguilla**
Members with no human capacity available for implementing QMS for aviation meteorological services	3	**British Virgin Islands Montserrat Saint Lucia**
Members with a Certified Quality Manager on active duty (part or full time)	2	**Barbados Trinidad & Tobago**
Members with Certified QMS Auditors tasked with QMS duties (part or full time)	6	**Barbados, Cayman Islands, Grenada Guyana, Jamaica, Trinidad & Tobago**
Members with Quality Manual and documentation developed	11	Quality Manuals, Standard Forms, Standard Operating Procedures (SOP) developed **Barbados, Belize, British Virgin Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, Saint Lucia, Turks and Caicos Islands, St Kitts and Nevis**
Members with Quality Manual and documentation developed but QMS ISO 9001:2015 not established	8	**Belize, British Virgin Islands, Dominica Grenada, Guyana, Jamaica, Montserrat Saint Lucia, Turks and Caicos Islands**
Members conducting internal audits within the last two (2) years	4	**Barbados, Cayman Islands, Guyana, Montserrat** Cayman Island completed a third-party audit, which is required for certification
Members with staff assigned to QMS that have attend non-certificate courses within the last 3 years	8	**Antigua and Barbuda, Barbados, Belize, Dominica, Grenada, Guyana, Montserrat, St Kitts and Nevis**
Members with no trained personnel or calibration equipment	9	**Antigua and Barbuda, Belize, British Virgin Islands ,Grenada, Guyana, Saint Lucia, St Kitts and Nevis, St Vincent & the Grenadines, Turks and Caicos Islands**

Gap Analysis

45.   The provisions of ISO 9001 have been interpreted for NMHSs through the creation of a **WMO QMS Implementation Checklist**. Using the WMO QMS implementation checklist, a gap analysis was conducted to identify areas within the main clauses of the ISO 9001:2015 requirements that were not being fully applied (or not applied at all) by Members.

Gap analysis results

Step 1: Top management endorsement

46.   All of the NMHSs' top management demonstrate some level of commitment to implementing a QMS. On a scale of 1 to 5, 68% of the NMHS provided a rating of 3 and below in the extent to which senior management demonstrate commitment to the QMS implementation. However, only five NMHS QMS staff gave a rating of 4 and above in this regard. Senior management commitment to QMS implementation is crucial for taking accountability, monitoring implementation, ensuring regular reporting, taking actions to close gaps, providing enough resources, driving review, and addressing implementation risks to ensure a culture of quality assurance is established.
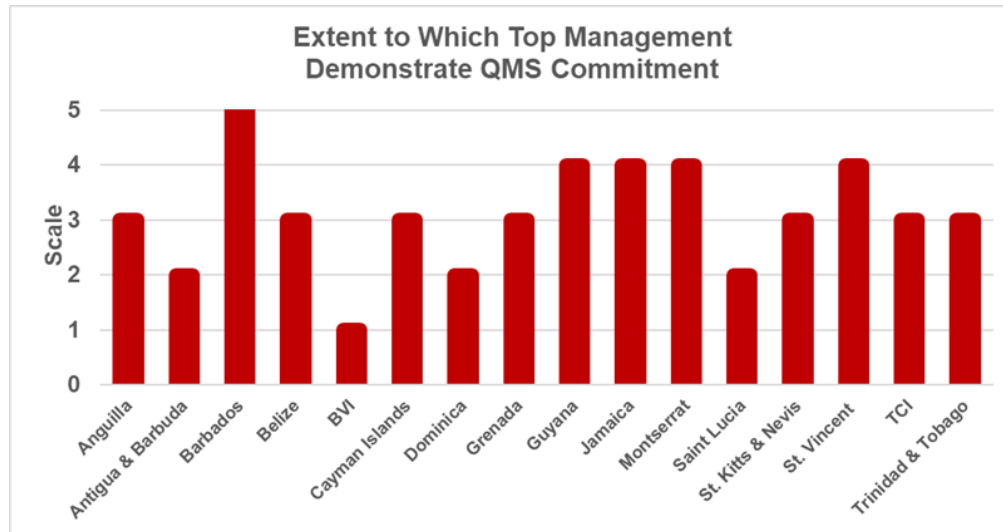
Figure 2.0 NMHSs responses to top management commitment to QMS implementation.

Step 2: Establish Quality Policy and Quality Objectives

47.   The results suggest that most of the NMHSs have established quality policy and quality objectives that are shared with staff. However, on a scale of 1 to 5, 88% of the NMHS indicated a rating of 3 and below with regard to how effectively the policy and objectives are communicated to staff by top management.

Step 3: Conduct QMS gap analysis to evaluate quality procedures and processes

48.   On the question of how well your NMHS addresses nonconformities (e.g., observational errors, inaccurate forecasts, human errors) and implements corrective actions, all but two Members gave a rating of 3 or above on the 1 – 5 rating scale. This suggests that methods exist at the NMHSs to identify gaps and areas where changes are needed. It is also indicative that there are established modes to take actions to ensure that the overall quality of their services achieve compliance.

Step 4: Provide QMS training

49.   A key component of quality management is staff training to ensure that staff carry out their job specifications effectively. Eight (8) Members NMHSs indicated that staff assigned to work on QMS participated in non-certificate courses (e.g., webinars) within the last 3 years. Yet still, nine (9) members indicated that training options in QMS documentation, implementation and auditing are few and there are limited practical skills in quality control and quality assurance for meteorology. The same nine Members requested training for the teams involved in QMS.

Step 5: Implemented Key Processes

50.   Sixty-nine percent (69%) of the Members NHMSs gave a rating of 3 or above for the extent of documented control on key processes for service delivery areas. It is assumed that documented control on key processes includes control of WMO regulations and other similar documents, control

of records, control of monitoring and, keeping of records such measuring devices as internal audit findings, non-conformance reports, and corrective actions, etc., which can be viewed as proof of operating in a controlled environment to ensure compliance standards are met, which exemplifies a Quality Management System.

Step 6: Prepare standard forms, work instructions, and standard operating procedures (SOPs)

51.   With regard to important documents such as standard forms, work instructions, and standard operating procedures that are needed as part of the QMS and how well these documents are controlled and managed, 75% of Members NMHSs gave a rating of 3 and above. This suggests that many of the NMHSs already have written procedures in place (hard or electronic copies), which may need updating or may need something as simple as a unique identifier to meet the controlled document requirements and enable compliance with QMS standards. These documents already ensure conformity and consistency in staff behaviour when performing duties, and uniform data recording methods.

Step 7: Develop performance measures or metrics to assess satisfaction

52.   Developing performance measures to assess customer satisfaction is a key process for monitoring and striving to achieve improvement. 88% of Member NMHSs indicated a rating of 3 or below on a scale of 1-5. Notably, 7 members (44%) gave a rating of 2 or 1.

Step 8. Maintain documented information and document control (Quality Manual)

53.   A QMS is the entire system that an organization uses to control, organize, and control documentation. Steps 2, 5, 6, and 7 typically make up what ISO 9001 refers to as the quality manual. In the 2015 edition, the quality manual is referred to as documented information. The results suggest that 75% of the Members NMHSs reasonably maintain a quality manual, based on 3 or above rating that was given.

Step 9: Conduct internal audits

54.   The keeping of records such as audit findings, data monitoring, non-conformance reports, and corrective actions etc. can be used as proof of QMS implementation and effectiveness. The majority (56%) of NMHS gave their frequency of internal audits a rating of 2 or less, while 5 NMHs gave a rating of 4. The WMO recommends undertaking internal audits twice a year to promote continuous improvement. The responses suggest that Members are not performing sufficient internal audits.

Summary of Identified Gaps Criticality to QMS Implementation

55.   The following table summarizes the level of criticality that have been imposed on the gaps found based on the ratings provided by Members. Each gap has been evaluated according to its level of criticality (low = green, middle = yellow, high = red) to help identify which gaps are most urgent to fill.

Table 3.0 Largest gaps found in QMS implementation at CMO Member States NMHSs

Gaps in NMHSs QMS Implementation	Criticality
Inadequate demonstration of senior management commitment to QMS	High
Insufficient internal audits	High
Insufficient customer satisfaction monitoring & measurement	High
Ineffective communication of quality policy	Medium
Inadequate staff training options provided for QMS	Medium
Missing SOPs, standard forms, work instructions	Low
Missing Quality manual	Low
Insufficient documented control on key processes	Low
No Gap analysis	Low

56. Many processes used by the NMHSs are based on, and make reference to standard and recommended procedures according to the WMO technical documentation, which suggest that the NMHSs already follow technical standards that are complementary to ISO 9001 requirements. Accordingly, most Members have the enabling components to easily commence implementation of a formal QMS to provide the assurance of meeting the WMO and ICAO relevant standards.

H. INTEGRATED HEALTH SCIENCE AND SERVICES

57. At Cg-19, WMO noted that health sectors currently underutilize available weather and climate services in making programmatic and financial decisions. As such, the WMO agreed to accelerate the implementation of lifesaving preparedness and early warnings of extreme heat and biological and other risks to human health to protect people from climate and health-related hazards, and added that this should occur in coordination with the Early Warning for All Initiative.

58. In this regard, WMO decided to further strengthen its efforts in health research and service delivery through the Implementation Plan for Advancing Integrated Climate, Environment, and Health Science and Services (2023–2033). This plan proposes innovative approaches, sustained mechanisms, and engagement opportunities for better health and well-being for people facing existing and emerging extreme weather events, climate change, and environmental risks through the effective integration of climate, environment, and health science and services. To this end, the WMO plans to assist Members in strengthening the capacities of their NMHSs and other providers and users of health-tailored meteorological information services to protect public health.

59. WMO also requested Members NMHSs to enhance their mandates to support the health sector and continue to nominate and support the work of health sector focal points for health-related research and services through collaboration to address increasing climate risks to health. Members were invited to implement catalytic services to better serve societal needs. In line with this, actions that Members NMHSs are expected to take include:
- Scale-up the products and services required to effectively support the health sector.
- Take actions to enhance the monitoring, forecasting, warning, and management of environmental health risks, such as extreme heat, ultraviolet (UV) radiation, and hazardous air quality.
- Contribute to the implementation of integrated health science and services by sharing current capacities, expertise and experience.

- Strengthen research and operational mechanisms, including the open sharing of meteorological and health data.
- Facilitate coordination and cooperation with other relevant actors within the health community on matters of climate, weather, water, and environmental health risks.

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November 2023

ANNEX I: REGIONAL WIGOS CENTRE

Main Steps and tasks for the Leading and contributing Nodes

60.   A quality or metadata management issue can be raised for a station or multiple stations by any user registered in the IMS or by a Leading or Contributing Node. Once this occurs, the Ln or Cn will follow the status of the issue before creating a ticket. If after following the status, the Ln or Cn decides to create an issue-ticket, it will be created in the IMS following the procedures and ticket structure defined in the Technical Guidelines for Regional WIGOS Centres in the WIGOS Data Quality Monitoring System (WMO No. 1224).

61.   If the issue-ticket that was created is related to quality monitoring, Ln/USA will follow the process for the issue-ticket. If the issue-ticket is related to metadata management, the created ticket will be assigned to Ln/Canada. After receiving an issue-ticket or creating an issue-ticket, Ln/USA or Ln/Canada will monitor the status of the issue for a certain period (5 days) to see if the issue is resolved or not. If the identified issue that led to the issue-ticket was resolved (or disappeared) without further action taken by the RWC, this will be highlighted as "No incident process required" in the IMS and the ticket will be closed or the performance of the station will be further monitored for another 2 days by the Ln before finally closing the issue.

Initiation of Incident Management Process

62.   If the status of the issue remains the same or gets worse during the monitoring period, the relevant Ln will initiate the incident management process in consultation with the relevant Cn by converting the issue-ticket to an incident-ticket. The incident-ticket will be assigned to Cn/Costa Rica for Spanish countries and to Cn/BCT-CMO or Cn/Trinidad and Tobago for English-speaking Caribbean countries. If the issue ticket is related to the USA, the issue will be followed by Ln/USA to its resolution. If the issue ticket is related to Canada, the issue will be followed by Ln/Canada to its resolution. If the issue ticket is related to Haiti (French-speaking country), the issue will be followed by Ln/Canada.

Notifying Members

63.   After receiving the incident-ticket assigned by Ln, the contributing nodes, Cn/Costa Rica, Cn/BCT-CMO or Cn/Trinidad and Tobago, will notify the relevant Member by assigning the incident-ticket to the WDQMS NFP of the relevant Member.

Actions required by Members

- As soon as a Member receives the incident-ticket from either Cn/Costa Rica, Cn/BCT-CMO, Cn/Trinidad and Tobago, Ln/USA or Ln/Canada, the WDQMS-NFP must send a confirmation response of the receipt of the incident-ticket, as explained in the guidance document **(WMO-No.1224).**
- The WDQMS-NFP of the country shall take actions to investigate the cause of the incident and find a solution.
- The WDQMS-NFP must initiate and coordinate the necessary actions with the engagement of all relevant parties to resolve the incident.

- As soon as the WDQMS-NFP of the country has identified the cause of the incident and found a solution, the Cn or Ln must be informed by the WDQMS-NFP of the proposed actions by adding relevant information to the incident-ticket in accordance with WMO-No.1224.
- The country's WDQMS-NFP must update the incident-ticket and inform the Cn or Ln about the update as soon as possible.
- The WDQMS NFP must regularly provide the Cn or Ln with summarized updates on the status of the incident as defined in the guidance document (WMO-No.1224).
- When the incident has been rectified, WDQMS-NFP should document the updates in the incident-ticket by adding the information in the ticket as defined in the guidance document (WMO-No.1224).
- If it is needed, WDQMS-NFP can ask for support and guidance from the Cn or Ln to develop and implement proper solutions to resolve the issue.

Interactive Actions by RWC

- Once an incident-ticket confirmation is received from the country by the Cn or Ln, the ticket status will be set to **"Under Investigation".**
- When the WDQMS-NFP informs the Cn or Ln that a process to find the cause of the incident has started and work is ongoing to resolve it, the ticket status will be updated to **"In Progress".**
- The Cn or Ln will update the date, ticket status, and other relevant parts of the ticket summary at least once a week, considering the feedback from the Member WDQMS-NFP.
- If it is found that an incident cannot be rectified because no (immediate) action can be taken, the Cn or Ln would set the ticket status as "Won`t Fix", close the ticket, and put the incident into the log of "Known Problems".
- If the incident is rectified by the Member, the Cn or Ln will close the incident-ticket and inform the WDQMS-NFP point about the closing of the incident-ticket

<u>Incident escalation</u>

- If there is **no response** from the **WDQMS-NFP** to the Cn or Ln about the actions regarding the incident ticket, the Cn or Ln will escalate the incident to the WMO Secretariat.
- The WMO Secretariat will communicate with the Permanent Representative of the Member or the designated higher-level representative to inform them about the status of the incident and the need to resolve it.
- After escalation, when any feedback is received from the Member, the process for resolving the issue will be followed by the Cn or Ln.