CARIBBEAN METEOROLOGICAL ORGANIZATION

REPORT OF THE

ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES

TORTOLA, THE VIRGIN ISLANDS (UK)

20 NOVEMBER 2024

INTRODUCTION

1.1 The 2024 Annual Meeting of the Directors of Meteorological Services (DMS2024) was hosted by the Government of the Virgin Islands (UK) at Maria's by The Sea Hotel & Restaurant, Tortola, on Wednesday, 20 November 2024. The Meeting was chaired by Dr. Arlene Laing, Coordinating Director of the CMO Headquarters.

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 PREVIOUS MEETING
(Agenda Item 2)

2.1 The CMO Headquarters produced a single document containing an Action Sheet that provided the Meeting with the opportunity to follow-up on or asked questions about actions taken to implement the decisions taken at the previous meeting and to discuss any further actions if required.

2.2 The Science and Technology Officer (STO), Mr. Kenneth Kerr delivered a presentation containing the status of actions taken to implement decisions of DMS2023 (Trinidad and Tobago, 2023).

2.3 There were two (2) items on the status of actions document from DMS 2023, which were dealt with during this agenda item, since the STO stated that the rest were going to be dealt with during the operational matters (agenda item 4).

2.4 The Meeting was informed that the CMO Headquarters in collaboration with the World Meteorological Organization (WMO) hosted the Caribbean NWP Capacity Development and Operational Readiness Workshop in Support of EW4All, which was held from 5-9 August 2024 in Port of Spain, Trinidad and Tobago. Also, all CMO Members NMHSs except Guyana and Dominica signed the agreement with the CMO Headquarters to participate in the CMO Caribbean WIS 2.0 Node, even though both countries were participating in the WIS 2.0 node. Following the presentation, the Chief Hydrometeorological Officer of the Hydrometeorological Service of Guyana signed off on the agreement.

TRAINING
(Agenda Item 3)

3.1 Ms. Kathy-Ann Caesar, Chief Meteorologist of the Caribbean Institute for Meteorology and Hydrology (CIMH), delivered a presentation on the meteorological training offered at the Institute during the period 2023–2024. The presentation provided details on completed, ongoing, and incomplete courses conducted by the Meteorological Section during the inter-sessional period. It also included information on certificates awarded, the number of passes, conditional passes, failures, withdrawals, and instances where the CIMH had to address cases of student misconduct, including cheating.

3.2 The Meeting was also informed of ongoing concerns regarding the quality of passes and the failure rate among students, both at the CIMH and at the Cave Hill Campus of the University of the West Indies (UWI), Barbados. Additionally, Ms. Caesar reported on the successful Aeronautical Meteorological Observers Training Course for air traffic controllers, which was conducted in the British Virgin Islands (BVI) from 2 September – 4 October 2024, as well as the in-house refresher training for Aeronautical Meteorological Observers held at the Trinidad and Tobago Meteorological Service in November 2024.

3.3 Reflecting on the Bridging Course conducted between 2022 and 2023, Ms. Caesar reminded the Meeting that the course was intended to prepare Senior Level Meteorological Technicians (SLMTs) and assess their readiness to advance successfully. She highlighted that students continued to face significant challenges with Mathematics and Physics, as well as difficulties with virtual classes.

3.4 The Meeting was informed that, for the Entry Level Meteorological Technician (ELMT) course, there were twenty-two (22) applications, but only twenty (20) students were accepted—four (4) beyond the ideal capacity. This over-enrolment placed a strain on the CIMH's limited and aging equipment. Unfortunately, one student experienced anxiety and had to be referred for counselling but was able to recover and complete the course. Three students experienced academic challenges, and one (1) student who was caught cheating during an examination was failed and removed from the programme. Additionally, two (2) students suffered injuries during the course, one of which required multiple medical consultations.

3.5 It was strongly recommended that NMHSs ensure that students attending courses in Barbados have appropriate insurance coverage. To address overcrowding, it was noted that since the ELMT course has a capacity of sixteen (16) students, the CIMH would consider offering a second ELMT course within the same year every five-year cycle.

3.6 The Meeting was also informed that the ongoing Mid-Level Meteorological Technician (MLMT) course, which traditionally enrolls smaller numbers, had only four (4) students registered—three (3) in the instrumentation stream and one (1) in the applied stream. The presentation noted that significant resources were being utilized to support such a small cohort, including fourteen (14) lecturers, which was not efficient. As a result, consideration will be given to establishing a minimum of five (5) students before conducting future MLMT courses. NMHSs will also be requested to submit training proposals for the period 2025–2030 to facilitate improved planning, advising, and management of upcoming courses.

3.7 It was further noted that during the 2024 academic year, enrolment in the UWI Meteorology Degree Programme was particularly low, with only three (3) students registered. While this was not considered alarming—given the overall decline in student numbers across the UWI system—the situation would continue to be monitored.

3.8 Ms. Caesar informed the Meeting that the final phase of UWI's Quality Assurance Unit (QAU) review of the UWI Meteorology Programme delivered by the CIMH had been completed, and that the final report would be shared with Directors. One of the key recommendations from the QAU was that, given the insufficient mathematical preparation of incoming students, the CIMH should develop and introduce a "Mathematics for Meteorology" course for first-year students.

3.9 The Chief Meteorologist reported that this recommendation had been completed, submitted, and approved by the Faculty, and was now under review by the other campuses and the UWI undergraduate programme. She noted that the CXC Mathematics pass rate across the region in 2024 was only 36%, indicating that this mathematical challenge would likely persist.

3.10 Ms. Caesar also highlighted several regional workshops that the CIMH had either collaborated on or co-produced, including: The WMO/NOAA RA IV Workshop on an Interactive Analysis of Tropical Storm Phillippe Satellite Data, the fourth collaboration between the CIMH and the Department of Atmospheric Sciences at Texas A&M University; the CIMH/NOAA-NHC Workshop under the Coastal Inundation Project for the Caribbean; and the CIMH's partnership with international research organizations on ORCESTRA—Organized Convection and EarthCare Studies over the Tropical Atlantic.

3.11 The Meeting was informed that the CIMH planned to update its observation equipment to better align with instruments used by NMHSs and to update its training curriculum to integrate the adopted RA IV Hurricane Forecaster Competency Framework, ensuring that forecaster training remains compliant with WMO standards.

3.12 The following recommendations were made: NMHSs planning to send staff to the SLMT course should consider having them complete CAPE Unit 1 courses prior to enrollment; NMHSs should ensure that staff participating in virtual or blended CIMH courses are provided with adequate space, time, and support to facilitate effective participation; Consideration should be given to increasing student stipends, given the rising cost of living in Barbados; and Succession planning should form part of NMHSs' strategic staffing plans over the next five (5) years in anticipation of staff retirements.

3.13 Following the presentation, the Meeting discussed issues related to stipends and mathematical challenges, among others. The Representative from Sint Maarten commended the CIMH for its work and recalled that the student stipend rate proposed by the CIMH in its correspondence to NMHSs was more than ten (10) years old. He recommended that the CIMH review and update the stipend amount to ensure that it adequately reflects the current cost of living for students attending the CIMH.

3.14 The Representatives from Anguilla and the Cayman Islands revisited the issue of mathematics deficiencies among ELMT students and inquired whether a pre-training mathematics course could be offered before enrollment at the CIMH. Ms. Caesar suggested that students should have CSEC-level Mathematics and that such preparatory courses were already available within countries and online. She encouraged NMHSs to require or facilitate participation in these courses prior to entry.

3.15 The Director of the Trinidad and Tobago Meteorological Service commended the CIMH for its efforts but recommended that it review the Mathematics and Physics syllabus, emphasizing the need to focus on the fundamental concepts required for meteorology. He stressed that governments were investing significant resources to train staff, and while most students excelled in meteorological components, many failed due to Mathematics, which prevented them from completing the course successfully. This, he noted, had operational consequences as staff were unable to advance and had to return to previous posts. He urged the CIMH to consider a more flexible approach to help students overcome these challenges, given the region-wide decline in mathematical competence.

3.16 Ms. Caesar reiterated that the CIMH is guided by WMO regulations, particularly the Basic Instruction Package for Meteorological Technicians (BIP-MT), which requires foundational knowledge in mathematics, physics, geography, and communication. She stressed that remedial training would assist in better preparing students for success.

3.17 The Principal of the CIMH cautioned that any changes to the mathematics curriculum should be carefully considered. He suggested that NMHSs may need to improve recruitment and marketing efforts to attract more suitable candidates. He warned that lowering academic standards could result in a decline in overall programme quality.

3.18 The Representative from the Dominica Meteorological Service inquired whether consideration was being given to adjusting the content of the MLMT Instrument Course, given the increase in automatic weather stations (AWS) and the reliance on the CIMH for maintenance support. He noted that it was financially prohibitive to require initial ELMT training before qualifying for the MLMT programme and recommended adjustments to increase access to training for staff involved in the maintenance and repair of AWS units.

3.19 Ms. Caesar responded that no changes had yet been considered, as instrument technicians must understand the principles behind the measurements, which are covered in the ELMT course. Nonetheless, given the valuable recommendation, the CIMH would explore possible adjustments to the course. However, for the time being, the ELMT remains a prerequisite for the MLMT programme.

OPERATIONAL MATTERS
(Agenda Item 4)

A. EARLY WARNING FOR ALL IMPLEMENTATION

4.1 The Meeting was reminded of the call for NMHSs to leverage the Early Warnings for All (EW4All) initiative by developing and implementing their own related activities and national initiatives. It was noted that the WMO had approved a list of High-Priority Activities Contributing to EW4All and had developed a Road Map for the Early Warnings for All Initiative, requesting that NMHSs use it to prioritize or accelerate their early warning programmes.

4.2 Members were also required to provide feedback on progress made, share successful examples where increased visibility and institutional authority had been gained within government, and demonstrate

how NMHSs were contributing to national disaster risk reduction efforts. It was emphasized that under the EW4All Road Map, the implementation of the Common Alerting Protocol (CAP) and Impact-Based Forecasting and Warnings (IBFW) remained key approaches for which the WMO was providing significant technical and training support.

4.3 The Meeting reviewed results from NMHSs that had invested in early warning platforms and engaged with vulnerable sectors, stakeholders, and communities. These efforts have enabled NMHSs to gain increased recognition within governments and advance early warning capabilities nationally. Notably, Dominica, Antigua and Barbuda, and Jamaica collaborated with the Caribbean Institute for Meteorology and Hydrology (CIMH) to host their first National Climate Outlook Forums (NCOFs), which provided actionable climate information to support preparedness planning and were attended by government ministers.

4.4 Directors were reminded that NMHSs are key partners in their governments' disaster management frameworks and play a critical role in supporting national political and policy agendas. They were encouraged to use these existing governmental linkages to advocate for the resources needed to sustain and expand early warning services. NMHSs were also urged to ensure that national early warning services address all country-relevant hazards identified in the Regional Priority Hazards List, to support and strengthen national EW4All implementation.

B. STRENGTHENING SERVICE CAPACITY, INCLUDING MARINE AND OCEAN SERVICES

4.5 The Meeting was informed that the WMO Road Map for EW4All supports the production of Impact-Based Forecast and Warning Services (IBFWS) by providing Members with access to training workshops and an expanded IBFWS eCourse, available at https://etrp.wmo.int/course/view.php?id=253. The WMO has also expanded dissemination tools by designating CAP as a recommended standard, with plans to integrate the IBF e-learning course and a CAP Editor Tool within the WIS 2.0 Box.

4.6 The Meeting recalled the Caribbean CAP Webinar Series, hosted earlier in 2024 by the CMO Headquarters, in collaboration with the CIMH and the WMO. Results from a survey conducted during the webinar showed that 70% of participants did not currently use CAP for warnings, while 83% expressed interest in adopting CAP for warning dissemination.

4.7 The Meeting was informed that Based on the survey findings, Dominica, Grenada, and Saint Lucia volunteered to host in-country CAP implementation workshops, to be funded under CREWS 2.0 and scheduled for the first quarter of 2025. The workshops aim to accelerate national CAP implementation by providing participants with practical, hands-on training in formatting warnings to CAP standards, mainstreaming CAP use in operational practice, and testing the newly developed WMO CAP Editor Tool integrated within the WIS 2.0 in a Box framework.

4.8 The workshops will utilize regional trainers from Jamaica and Trinidad and Tobago, using the WMO CAP Composer to strengthen regional expertise and self-sufficiency in CAP implementation. A brief introduction to impact-based forecasting will also be included in the sessions. The Meeting was reminded that, as island and coastal states, marine meteorology is critical to the CMO Member States, given their dependence on the ocean for economic sustainability and development. It was noted that only five (5) NMHSs currently provide dedicated marine services, while the remaining eleven (11) incorporate aspects of marine meteorology into their general public weather forecasts.

4.9 The Meeting was informed that WMO had developed and published a five-year Marine Services Implementation Plan, outlining the requirements for marine services, which Members can use as a guide in developing or expanding their national offerings. Directors were also reminded that, under WMO competencies, marine and ocean forecasts should include relevant weather phenomena, parameters, and variables such as spatial extent, onset and cessation, duration, intensity, and temporal variations for high seas and coastal areas. In line with this, Grenada's twice-daily marine bulletin was highlighted as a best practice, as it met all WMO requirements for marine services, in addition to being colour-coded and impact-based, and could serve as a model for replication by other NMHSs. The Meeting noted the successful

conduct of the Caribbean NWP Capacity Development and Operational Readiness Workshop in Support of EW4All, held from 5–9 August 2024 in Port of Spain, Trinidad and Tobago, through collaboration between the CMO Headquarters and the WMO.

4.10 Directors were informed that the workshop was attended by 23 participants from 12 CMO Member States, as well as representatives from Sint Maarten, Costa Rica, and the WMO Regional Training Centres in Barbados (CIMH) and Costa Rica. Participants successfully ran 24–72-hour Numerical Weather Prediction (NWP) simulations for their countries and territories, at spatial resolutions of 1 km, 3 km, and 9 km, and temporal resolutions of 1 hour, 3 hours, and 6 hours.

4.11 All CMO Member States left the workshop equipped with a WRF (ARF-based) PN Tool, configured for national circumstances and ready for use in real-time operations, case studies, and research. The workshop addressed Members' requests for enhanced capacity to deliver high-quality hydrometeorological and early warning services in support of the global EW4All initiative.

4.12 Directors were encouraged to allocate resources to integrate the WRF-based PN Tool into their real-time operational forecasting systems, to strengthen NMHS operational capacity. They were also reminded that service capacity could be further enhanced through increased use of the high-resolution products of limited-area NWP models available via the Severe Weather Forecasting Programme (SWFP) Extranet, hosted by Météo-France Martinique.

C. WIGOS IMPLEMENTATION: OSCAR/SURFACE, REGIONAL WIGOS CENTRE, GLOBAL BASIC OBSERVATION NETWORK (GBON) AND THE ASSOCIATED SYSTEMATIC OBSERVATION FINANCING FACILITY (SOFF)

4.13 The meeting recalled previous discussions on the implementation of the WMO Integrated Global Observing System (WIGOS) operational plan and the request for Directors to close outstanding implementation gaps. Since that time, most CMO Member NMHSs have advanced their WIGOS implementation and increased compliance, though progress remains uneven among Members.

4.14 Directors were informed that all sixteen (16) CMO NMHSs have designated functional National Focal Points (NFPs) in the required WIGOS areas. Additionally, there was an increase from two (2) to nine (9) NMHSs that have developed and implemented National WIGOS Station Identifier (WSI) systems—an essential step for data exchange from new Global Basic Observation Network (GBON) stations.

4.15 The Meeting was further informed that WIGOS implementation efforts supported by the CMO Headquarters had yielded several key outcomes aligned with WMO RA IV regional priorities and the CMO Headquarters Strategic Plan, particularly in improving the number of NMHSs with functional WIGOS-related NFPs trained on WIGOS, WDQMS, and OSCAR/Surface. However, some NFPs still required additional training to fully understand programme interlinkages and responsibilities.

4.16 Despite these gains, there remained a significant gap in the number of Members with National WIGOS Implementation Plans (WIPs)—one of the priority areas under the WIGOS Operational Plan. At the time of reporting, only Barbados and Belize had begun developing their national WIPs.

4.17 Directors were informed that the WMO Technical Guidelines for Regional WIGOS Centres (RWCs) on the WIGOS Data Quality Monitoring System (WDQMS) (WMO-No. 1224) had been updated and were now available to guide RWCs in performing operational activities related to WDQMS. The Meeting was reminded that the RA IV Regional WIGOS Centre (RWC) began operating in pilot mode on 21 December 2023, with two leading nodes (USA and Canada) and three contributing nodes (Costa Rica, Trinidad and Tobago, and the CMO Headquarters – British Caribbean Territories [CMO HQ/BCT]). The CMO HQ/BCT and Trinidad and Tobago nodes currently assist Members in addressing data availability and quality issues identified via the WDQMS and Incident Management System (IMS), and in managing metadata within OSCAR/Surface.

4.18 Further, these efforts resulted in improved data availability and quality from CMO Members' WIGOS stations. As of October 2024, observation availability ranged from 7% to 100%, with 18 of 26 stations meeting or exceeding the 80% performance target. However, eight (8) stations reported fewer than 80% of expected observations (see Table 2.0). It was further noted that Anguilla, Belize, the British Virgin Islands, Jamaica, Saint Lucia, and the Turks and Caicos Islands experienced the most persistent data availability issues, likely reflecting capacity gaps. These issues appeared to be confined mainly to surface observations, as upper-air stations performed significantly better—ranging from 55% to 100%, with four (4) of five (5) operating at full performance. Equipment failures, such as with hydrogen generators, as well as other operational constraints, were also cited as factors occasionally affecting Members' data availability and GBON compliance.

4.19 Directors were informed that the WMO had implemented a dedicated web tool (gbon-compliance.wmo.int) to monitor compliance and reporting for GBON surface and upper-air stations over land. This tool uses data from the WMO Integrated Global Observing System (WIGOS) Data Quality Monitoring System (WDQMS), launched at INFCOM-3. Compliance is assessed based on the criteria outlined in Section 11.4 of the *Guide to the WMO Integrated Global Observing System* (WMO-No. 1165).

4.20 The meeting recalled that GBON compliance consists of two components: Member-level compliance and station-level compliance. Trends among CMO Member States' NMHSs remained positive across both criteria. All CMO Members met the Member-level compliance horizontal resolution requirement based on reporting stations. Notably, Belize, Cayman Islands, Dominica, St. Kitts and Nevis, and Trinidad and Tobago exceeded the GBON minimum horizontal resolution target of one station, determined through global GBON gap analysis. Station-level compliance in terms of data quality remained positive; however, significant gaps persisted regarding reporting frequency and data availability on a quarterly basis.

4.21 It was highlighted that, in response to GBON regulations and regional collaboration, surface observation data reporting by CMO Member States' NMHSs had increased at national, regional, and international levels. Several stations were approaching full GBON station-level compliance since DMS2023. Nonetheless, achieving full station-level compliance remains challenging due to the mix of manual and Automatic Weather Stations (AWS) contributing to GBON reporting. Integration of data collection and reporting via WIS 2.0 nodes is complicated when both types of stations are used.

4.22 The Meeting was informed that the number of Members reporting observational data from GBON-declared stations at the required hourly frequency increased from eight (8) at DMS2023 to thirteen (13) at DMS2024 (Table 4.0). The five additional Members reporting hourly were Anguilla, British Virgin Islands, Dominica, Montserrat, and Saint Vincent and the Grenadines.

4.23 The Meeting was cautioned that despite this improvement, significant gaps remain in achieving full GBON compliance. Only a small fraction of CMO Members met the standard of reporting hourly observations for 24 hours. Five (5) out of sixteen (16) Members (31%) with GBON-declared stations achieved full compliance: Antigua and Barbuda, Barbados, Grenada, Guyana, and Trinidad and Tobago (Table 3.0).

4.24 Directors were asked to note that seven (7) CMO Members—Anguilla, British Virgin Islands, Dominica, Montserrat, St. Kitts and Nevis, St. Vincent and the Grenadines, and Turks and Caicos—operate manned surface stations exchanging hourly observations but with shortened operational hours, preventing full 24-hour compliance. Additionally, Belize, Jamaica, and Saint Lucia were not reporting hourly observations; instead, they submitted data every three hours, which does not meet GBON requirements.

4.25 Observations from Trinidad and Tobago's upper-air GBON station returned to compliance with the mandatory two daily upper-air observations. From June 5 to October 31, 2024, Trinidad and Tobago provided 148 additional upper-air observations supporting global NWP, regional and local forecasts, warnings, and climate services.

4.26 Directors were informed that the 2024 edition of the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160) now includes provisions for GBON surface marine meteorological stations/platforms within Members' Exclusive Economic Zones (EEZ) in paragraph 3.2.2.10, a measure strongly advocated by the CMO.

4.27 The Meeting was reminded that the initial scope of the Systematic Observations Financing Facility (SOFF) focused on supporting surface and upper-air GBON land stations. With the inclusion of marine surface observation stations in GBON, WMO is now encouraging Members to operate surface marine stations. WMO has also requested that SOFF consider expanding its support to cover surface marine GBON stations/platforms within the Exclusive Economic Zones (EEZs) of Small Island Developing States (SIDS). This increases the likelihood that SOFF support may be extended to marine observations.

4.28 Directors were encouraged to operate surface marine stations as GBON stations where feasible and to begin developing plans for implementing marine observations that contribute to GBON. Collaboration with key marine-sector stakeholders should be considered, taking into account deployment and maintenance of marine observing equipment.

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4.30 Directors were encouraged to operate surface marine stations as GBON stations where feasible and to begin developing plans for implementing marine observations that contribute to GBON. Collaboration with key marine-sector stakeholders should be considered, taking into account deployment and maintenance of marine observing equipment.

D. WMO INFORMATION SYSTEM (WIS) 2.0

4.31 The Meeting recalled that the second generation of the WMO Information System (WIS 2.0) entered its pre-operational phase in January 2024. Directors were reminded that WIS 2.0 would officially transition to its operational phase on 1 January 2025, with full implementation expected by 2030, while the Global Telecommunication System (GTS) is scheduled for decommissioning by 2033.

4.32 Significant information on WIS 2.0 is provided in Resolution 15 (EC-78): Amendments to the Manual on WMO Information System, Volume II—WMO Information Systems 2.0 (WMO-No. 1160). The manual specifies that, during the operational phase, NMHSs (National Centers) serving as WIS Centers are responsible for publishing data and discovery metadata through a WIS 2.0 node. Each Permanent Representative is accountable for ensuring their centers comply with WIS standards and practices. Additionally, Resolution 16 (EC-78): Transition Guide from WIS 1.0 and GTS to WIS 2.0, including Capacity Development provides detailed instructions for transitioning from WIS 1.0 and GTS to WIS 2.0.

4.33 The Meeting recalled the CMO Headquarters implementation of the Caribbean WIS 2.0 Node, which was supported by WMO through an agreement with CMO and was informed that the WIS2.0 node continued to be operational with day-to-day monitoring and troubleshooting provided by the National Meteorological Service of Trinidad and Tobago and Belize, along with the CMO Headquarters Unit.

4.34 Directors were reminded that at DMS2023, it was reported that eleven (11) of the sixteen (16) CMO Members NMHSs were exchanging observations in BUFR format using their implemented WIS2.0 node. However, as of 31 October 2024, all sixteen (16) CMO Members NMHSs had successfully implemented WIS 2.0 nodes and were exchanging observations internationally from at least one station using their WIS 2.0 node, as shown in Table 4.0. Thirteen (13) CMO Members implemented their WIS 2.0 node on the CMO reference WIS 2.0 node, while three CMO Members, namely Barbados, Belize, and Trinidad and Tobago, implemented their own WIS 2.0 nodes. Additionally, the Bahamas and Sint Maarten requested and were allowed to set up their WIS2 Nodes on the Caribbean reference WIS 2.0 Node.

4.35 Directors were additionally informed that all of CMO Members NMHS WIS 2.0 nodes were configured to exchange observation data hourly during operational hours in keeping with the requirements of GBON. However, not all CMO Members NHMSs were achieving GBON compliance. The level of hourly

data exchanged using WIS 2.0 was above 80% for 12 CMO Members and intermittent for others, with below 30% hourly observation exchange via WIS 2.0 for Antigua and Barbuda, and Jamaica, while Saint Lucia's exchanged of hourly observations ranges between 38% and 67%.

4.36 The Meeting agreed that CMO Member States NMHSs should form a CMO Operational WIS 2 Node Execution Team (CO-WET) consisting of WIS 2.0 trained personnel with the National Meteorological Service of Belize and Trinidad and Tobago as co-leads, and at least five additional participants from Members with national WIS 2.0 Nodes on the CMO WIS 2.0 Node. The role of CO-WET was to manage and troubleshoot issues on the CMO WIS 2.0 Node when they arise, with support from WMO experts.

4.37 Further, Directors were to take actions to ensure designated focal points for the Caribbean WIS 2.0 node provided day-to-day monitoring and operational support to ensure sustainability of the CMO Headquarters implemented reference WIS 2.0 node. NMHSs that had fully migrated their data exchange operations to WIS 2.0 would communicate this to the WMO Secretariat and must keep the WIS 1.0 and GTS operating in parallel with the WIS 2.0 systems until receipt of communication from the WMO Secretariat.

4.38 Additionally, Directors were to continue migrating their NMHS (National Center) existing meteorological data exchange to WIS 2.0. All new station data were to be exchanged using WIS 2.0 after December 2024.

4.39 The Meeting recalled the presentation at DMS2023 by Dwayne Scott of the NMS of Belize on the mature state of development of the NMSB Climate Database Management System (CDMS) called System for Unified Real-time Forecasting of Atmospheric and Climatic Events (SURFACE-CDMS) that was being developed using open-source technologies and WMO Climate Data Model (CDM) standards under the WMO OpenCDMS project.

4.40 The Meeting heard that SURFACE-CDMS is open-source, free, customizable to national requirements, compliant with WMO guidelines, and aimed at advancing national and international data exchange. SURFACE CDMS allowed a NMHS to ingest, store, process, and output weather station data to the WIS 2.0 node in a seamless manner and was viewed as bespoke and innovative work from the region that can be integrated with the WIS 2.0 Box for automatic exchange of data, which satisfied the CDMS needs of CMO Members NMHS.

4.41 Directors were informed that Belize SURFACE-CDMS was scheduled for a beta release by November 2025, with piloting and testing scheduled from November 2024 to April 2025. For the sustainability of the SURFACE-CDMS, it was important for CMO Members NMHSs to support the piloting and testing of the SURFACE CDMS. Directors were urged to agree to the integration of the SURFACE-CDMS with their WIS 2.0 node and use the SURFACE-CDMS operationally as their NMHS climate data management system and operations. Additionally, Directors were requested to provide a focal point for the NMS of Belize to liaise with during participation in the piloting, testing, and use of the SURFACE CDMS.

4.42 The Science and Technology Officer informed the Meeting that implementation of key priorities for the provision of aeronautical meteorological services, that were necessary to achieve compliance with the Standards and Recommended Practices (SARPs) in ICAO Annex 3, remain delayed for most CMO Member State NMHSs. In particular, progress on the implementation of the ICAO Meteorological Information Exchange Model (IWXXM) for aviation weather information exchange, as well as the adoption of Quality Management Systems (QMS) in aeronautical meteorological service processes, had not advanced since DMS2023.

4.43 The Meeting recalled discussions on IWXXM, which became an ICAO Annex 3 standard in November 2020 for the operational exchange of aviation meteorological information. To date, only three (3) CMO Member States—Barbados, Guyana, and Trinidad and Tobago—exchange aeronautical meteorological information using IWXXM.

4.44 Directors were informed that ICAO plans to remove the generation of Traditional Alphanumeric Code (TAC) messages as a standard from Annex 3 in 2029. While Members may continue generating TAC messages, there will be no ICAO requirement for their international distribution beyond 2029. Currently,

TAC remains a standard in Annex 3, providing some flexibility for the next 3–4 years for Members to exchange aviation meteorological data (METAR, SPECI, TAF, etc.) using TAC. However, CMO Members must consider system changes to migrate to IWXXM by 2029, either through TAC-to-IWXXM translation capabilities or, preferably, by directly generating IWXXM messages without TAC.

4.45 The Meeting was pointed to the updated *Guide to the WMO Information System* (WMO-No. 1061), Section 2.8.1.1, "Publishing Aviation Weather Data from WIS 2.0 into ICAO SWIM," notes that a National Meteorological Service designated by its ICAO Contracting State may provide aeronautical meteorological information into SWIM (System Wide Information Management). IWXXM messaging is a core component of SWIM. The Guide also explains how an NMHS can efficiently provide aviation meteorology data to both WIS 2.0 and SWIM via an interoperability approach, where data published through WIS 2.0 is automatically propagated to SWIM using a WIS 2.0-to-SWIM Gateway. This approach, however, addresses only the publishing of WIS 2.0 data into SWIM.

E. STATE OF THE CLIMATE REPORTS

4.46 The Meeting was updated on the status of the WMO Annual State of the Climate Report, which summarizes key climate indicators, extreme events, and impacts, providing the latest findings on climate-related risks, including food security and population displacement. Members were reminded that in August 2024, WMO began preparing the 2024 report, collecting extreme and high-impact events data, and compiling a year-to-date climate summary from Members. A global summary statement will be released at COP29 in November 2024, with the full report published in March/April 2025.

4.47 The meeting was reminded that as of 31 October 2024, eight (8) CMO Members had submitted their year-to-date climate summaries and data on extreme/high-impact events for 2024. Members who had not submitted summaries were encouraged to continue monthly updates for final submission in early 2025. Those who have not submitted are urged to begin developing their annual summary.

F. BUSINESS CONTINUITY MANAGEMENT

4.48 It was reiterated that CMO Member NMHSs face significant business continuity risks, as the demands on operational meteorologists, staff, services, communications, ICT systems, and monitoring infrastructure can escalate sharply during severe events. Thus, maintaining uninterrupted operations is critical for NMHSs to deliver essential services, including continuous access to human resources during extreme weather or other natural or man-made hazards. Accordingly, it is essential for NMHSs to implement a comprehensive business continuity.

4.49 The Meeting was reminded that in June 2024, WMO EC-78 endorsed the Business Continuity Management Guidelines 2024 (BCM), recommended by SERCOM 3, to support NMHSs in sustaining operations during disasters or crises. The Guidelines outline organizational structure, scope, and fundamental requirements for establishing and maintaining business continuity management within NMHSs. They provide a step-by-step approach with practical guidance and examples relevant to NMHS operations and are supplemented with annexes and links to BCM plans from several NMHSs.

4.50 Directors were encouraged to assess these hazardous scenarios and adopt the sustainable practices outlined in the BCM Guidelines to develop plans that ensure continuous operations and operational resilience. Implementing such measures is essential to guarantee the delivery of critical services and products, safeguard lives, livelihoods, and property, and meet legal or other obligations, despite risks posed by natural or man-made hazards.

4.51 The Meeting agreed to propose the following actions to the Council:

I. Agree to and approve the formation of the CMO Operational WIS 2 Node Execution Team (COWNET) consisting of WIS 2.0 trained personnel from the CMO Member States National Meteorological Services with Belize and Trinidad and Tobago as co-leads, and at least five additional participants from Members with national WIS 2.0 Nodes on the CMO WIS 2.0 Node. The role of COWNET will be to manage and troubleshoot issues on the CMO WIS 2.0 Node when they arise, with support from WMO experts.

II. Endorse the decision of Directors to agree to supporting the integration of the Belize National Meteorological Service SURFACE-CDMS within their WIS 2.0 node and using the SURFACE-CDMS operationally for climate data management and operations.

OUTCOME/HIGHLIGHTS FROM WMO TECHNICAL COMMISSIONS & THE 78TH SESSION OF THE EXECUTIVE COUNCIL

(Agenda Item 5)

A. REGIONAL BASIC OBSERVING NETWORK (RBON)

5.1 The Science and Technology Officer stated that the Regional Basic Observing Network (RBON) is designed to consist of surface-based meteorological, hydrological, and related observing stations and platforms addressing regional priorities and needs. RBON aims to strengthen observation capabilities to support weather, water, climate, and related environmental services. The Meeting was informed that at the Third Session of the WMO Commission on Observation, Infrastructure and Information Systems (INFCOM-3), the updated RBON design and operation process was approved and incorporated into the Guide to WIGOS (WMO-No. 1165, 2024 Edition). The new approach mandates that Members design their RBONs based on user observational requirements contained in the OSCAR/Requirements database, with specific attention to the Early Warnings for All (EW4All) initiative.

5.2 The Meeting recalled that RBON stations should only be designated if they meet one or more WMO application area requirements and if their data are shared internationally in real-time or near-real time. The Regional Association is to develop a roadmap for addressing remaining observational gaps. Further, EC-78 Resolution 2 endorsed the RBON Work Plan as part of the infrastructure components of the EW4All initiative, with defined milestones and deliverables (Table 1.0). The plan calls for Regional Associations (RAs) and Members to identify national and regional priority hazards and to provide data on existing observational capabilities to inform gap analyses and future network design.

5.3 The Science and Technology Officer informed the Meeting that RA IV had approved its list of regional priority hazards, which will guide RBON development in the Caribbean region. Directors were reminded that National Meteorological and Hydrological Services (NMHSs) are expected to develop lists of national priority hazards, identify national observational requirements, develop or update National WIGOS Implementation Plans, and ensure inclusion of data from agrometeorological, hydrological, marine, environmental, energy, health, and remote-sensing domains.

B. WMO INTEGRATED PROCESSING AND PREDICTION SYSTEM (WIPPS)

5.4 The Meeting was informed that EC-78 Resolution 18 approved amendments to the Manual on the WMO Integrated Processing and Prediction System (WIPPS, WMO-No. 485) to enhance global and regional numerical prediction capabilities in support of EW4All and the WMO Unified Data Policy. The Meeting noted that eleven (11) new WIPPS-designated centres had been approved, expanding access to global products useful for regional and local forecasting.

5.5 The upgraded WIPPS provided increased core data from World Meteorological Centres (WMCs), enhanced forecast and analysis products at higher temporal and spatial resolutions, new products including impact-based indices and tropical cyclone guidance, and there were five new WIPPS activities covering global reanalysis, vegetation fire and smoke forecasting, marine emergency response, and global storm surge prediction.

C. CLIMATE MONITORING AND EARLY WARNING SYSTEMS

5.6 The Meeting was informed that EC-78 Resolution 5 approved an Implementation Plan for National Drought Early Warning Systems (NDEWS), structured around three pillars of Integrated Drought Management, namely drought monitoring and early warning, drought risk and impact assessment; and

drought risk mitigation, preparedness, and response. The Science and Technology Officer informed the Meeting that the Implementation Plan included seven objectives focused on enhancing drought monitoring, prediction, data exchange, impact collection, and integration with disaster risk reduction frameworks.

5.7 Further, SERCOM-3 Resolution 6 requires NMHSs to use a minimum set of drought indicators, now including both the Standardized Precipitation Index (SPI) and the Standardized Precipitation and Evapotranspiration Index (SPEI), with consideration of the Combined Drought Index (CDI) where feasible. The Meeting recalled that EC-78 also adopted amendments to WMO-No. 1160 (WIGOS Technical Regulations), requiring Members to adhere to updated Global Climate Observing System (GCOS) principles, implement the international exchange of daily climate data (DAYCLI), and transmit DAYCLI and CLIMAT reports by the 5th day of each month.

D. GLOBAL GREENHOUSE GAS WATCH (G3W)

5.8 The Meeting was informed that EC-78 Resolution 3 approved the Implementation Plan for the Global Greenhouse Gas Watch (G3W), which aims to provide actionable information to support Members' Nationally Determined Contributions (NDCs) and long-term emission reduction strategies. The Science and Technology Officer explained that the plan adopts a phased approach (2024–2027) beginning with monitoring of CO_2, CH_4, and N_2O, addressing both anthropogenic and natural sources.

E. WMO RADIO FREQUENCY COORDINATION

5.9 The Meeting was reminded that access to the radio spectrum is critical for meteorological observations and forecasting. The Science and Technology Officer informed the Meeting that the World Radio Communication Conference 2023 (WRC-23) outcomes were generally positive for the meteorological community. The Meeting noted that INFCOM-3 established a network of national focal points to enhance understanding of the Radio Frequency Regulatory framework within NMHSs. The network aims to strengthen advocacy for protecting frequency bands essential for Earth observation, including those related to sea surface temperature (SST) and space weather observations. Directors were encouraged to respond to WMO's request and nominate National Focal Points for Radio Frequency Coordination.

F. TROPICAL CYCLONE COMPETENCY FRAMEWORK (TCFCF)

5.10 The Science and Technology Officer informed the Meeting that SERCOM-3 Decision 6 approved the Tropical Cyclone Forecasting Competency Framework (TCFCF) for inclusion in the Compendium of WMO Competency Frameworks (WMO-No. 1209). Further, that the TCFCF defines competencies at three levels, namely senior TC forecasters at Regional Specialized Meteorological Centres (RSMCs)/Tropical Cyclone Warning Centres (TCWCs), forecasters in NMHSs receiving RSMC/TCWC guidance, and specific to RA IV, trained forecasters or meteorological technicians responsible for liaising with regional centres and communicating impact-based information to disaster managers and local stakeholders. The Meeting agreed that implementation of the TCFCF would enhance regional capacity for effective tropical cyclone forecasting and warning dissemination.

IMPACTS OF WEATHER IN 2024 (LOSSES, DAMAGES, BEST PRACTICES, CHALLENGES)

(Agenda Item 6)

6.1 The 2024 severe weather season across the Caribbean was active and multifaceted, featuring a range of tropical cyclones, heavy rainfall, flooding, and heat events characterized as a series of impactful events, despite variations in scale and geography. The following summarizes the key hazards and events faced by Member States.

6.2 **Anguilla:** Mr. Jeffrey Jennings reported that Anguilla experienced no major weather impacts in 2024. Minor light to moderate flooding occurred. The highest temperatures averaged around 32°C for several months. Rainfall was a primary concern, with a monthly average of ~4 inches with July experiencing up to 9 inches.

6.3 **Antigua and Barbuda:** Mr. Dale Destine reported that Antigua and Barbuda experienced a trouble-free hurricane season despite the country's location. Tropical storm Earnest threaten Antigua and Barbuda in August brining minimal rainfall, gusts up to 68 mph. The country experienced a few sea-breeze convergence events that caused intense, localized rainfall. On 15 June, 180.9 mm of rainfall was recorded in a 6-hour period in the vicinity of St John, on 16 June, another 176.2 millimeters rain fell in a 24-hour period and on 17 June, 133.1 millimeters of rain fell in 6 hours in a very small area. This led to flooding and traffic disruptions.

6.4 **Barbados:** Mr. Brian Murray informed the meeting that early tracking of Hurricane Beryl indicated Barbados was at risk, prompting preemptive monitoring and advisories. Close coordination occurred with neighboring islands Grenada, and Trinidad and Tobago and the National Hurricane Center to ensure accurate forecasting and timely warnings. Barbados experienced moderate wind and rainfall directly from Hurricane Beryl with localized flooding in low-lying areas. Some roofs were also blown off and there was some damage at the Grantley Adams International Airport.

6.5 However, as Hurricane Barrel passed to the south over the island of Carriacou, Barbados received significant storm surge, which caused significant damage to over 200 boats along both northeast and southern coasts. Early damage assessment estimated that around 40 houses were damaged. The meeting was informed that prior to Beryl, the country experienced a small line of thunderstorms on June 18 very small line of thunderstorms passing over Barbados, which produced light that caused a fire to one of the buildings that held important documents.

Belize: Mr. Ronald Gordon presented a comprehensive overview of Belize's 2024 wet and hurricane season, highlighting extreme heat and wildfires, and multiple tropical storm impacts. The main events and impacts were extreme Heat and Wildfires (April–May 2024) when Belize experienced record-breaking temperatures, reaching 100°F at the Philip Goldson International Airport—the highest ever recorded in the country.

6.6 The extreme heat and prolonged dry spell triggered the worst wildfire season in Belize's history, destroying extensive forest areas and damaging agricultural lands. Tropical Storm Beryl (July 2024) passed north of Belize without direct landfall but prompted tropical storm watches for the northern districts due to potential outer-band effects. The storm caused minimal impacts, primarily rainfall and moderate winds.

6.7 Tropical Storm Nadine (October 19 2024) made direct landfall in Belize with sustained winds near 60 mph, producing 3–9 inches of rainfall across northern and central regions. Widespread flooding followed, particularly in low-lying areas, displacing several families but causing no fatalities or major injuries. Persistent moist conditions after the storm worsened flooding for nearly two weeks. Tropical Storm Sarah.

6.8 **British Virgin Islands (BVI):** Mr. Andrew Jackson of the Virgin Islands (UK) provided an overview of the 2024 hurricane and wet season impacts in the British Virgin Islands (BVI), highlighting key weather events, operational challenges, and best practices. During 2024, the territory experienced several significant flooding events (May 7–8, June 5–6, and November 10–11) and major impacts from Tropical Storm Ernesto, which brought heavy rainfall and maximum wind gusts of 105 mph, particularly affecting Tortola and Virgin Gorda. Average rainfall across the islands reached 4–5 inches, with localized totals exceeding 8 inches. Due to the mountainous terrain of the BVI, runoff from intense rainfall frequently caused flash flooding and landslides. Damage assessments included flooded town centers, coastal inundation due to high tides, and slope failures in Virgin Gorda.

6.9 **Cayman Islands:** Mr. John Tibbetts, Director General, Cayman Islands National Weather Service presented an overview of the 2024 meteorological year in the Cayman Islands, describing it as an unusually active year with five significant weather systems, including a rare strong cold front in February and three named tropical cyclones—Hurricanes Beryl, Helene, and Raphael. He informed the meeting the key weather events and impacts included a February 2 Cold Front which produced near-gale force winds (25–30 knots) and 9–11 ft. waves, causing approximately USD 2.7 million in damages. The storm affected all three islands, damaging ports and coastal infrastructure, particularly in Georgetown and Cayman Brac.

6.10 Hurricane Beryl (July 4) passed 47 miles southwest of Grand Cayman as a Category 3 hurricane, with maximum winds of 40 knots (gusts to 56 knots) and 3.1 inches of rainfall. Despite the close proximity, impacts were limited due to effective forecasting and preparedness measures. Estimated damages: USD 2.1 million.

6.11 Potential Tropical Cyclone Nine / Hurricane Helene passed 91 miles southwest of Grand Cayman, producing 12.5 inches of rainfall and a 60-knot gust in Cayman Brac. Hurricane Raphael (November 5) passed 14 miles west of Little Cayman, delivering gusts up to 66 knots and 11 inches of rainfall in Cayman Brac. Hurricane warnings were issued promptly. Minor delays in reopening the airport occurred due to lingering feeder.

6.12 The other systems were a June flooding (June 8–10) event due to an upper-level trough and moisture buildup, which led to 11.3 inches of rainfall and widespread flooding, officially marking the start of the rainy season. Flood warnings were issued well in advance.

6.13 **Grenada:** Mr. Gerard Tamar of Grenada reported on the impact of dangerous Category 5 Hurricane Beryl, which made a direct hit on Grenada and its dependencies, devastated Petite Martinique and Carriacou. The meeting was informed that Beryl unleashed maximum sustained winds of 150 knots and minimum pressure of 950 hPa when it impacted Grenada and its dependencies Petite Martinique and Carriacou. Heavy rainfall totaling 261 mm was recorded. There were three confirmed deaths (1 in mainland Grenada, 2 in Carriacou. Estimated economic losses was USD $218 million, with Carriacou and Petite Martinique hardest hit. Later in the year 12 November, the country was impacted by the Inter-Tropical Convergence Zone (ITCZ) that caused significant damage, especially to mainland Grenada.

6.14 **Guyana:** Mr. Garvin McPherson of Guyana reported record-breaking heat, heavy rainfall and flooding, and damaging thunderstorm winds were main weather events and impacts. He stated that 2024 marked one of Guyana's hottest years on record. The Lethem station (southern Guyana) recorded 38.5°C, the highest temperature ever observed in the country. Many locations, including Georgetown and interior regions, registered temperatures 1–2°C above normal for both maximum and minimum readings. Prolonged hot and dry spells intensified public health and agricultural concerns. There was below-normal rainfall for most of the year except during the May–July rainy season, when tropical waves and the Intertropical Convergence Zone (ITCZ) brought widespread precipitation.

6.15 Rainfall was mainly driven by local convection, producing intense but localized downpours. Region 10 (Upper Demerara-Berbice) experienced severe flooding due to heavy rainfall, poor drainage, and ongoing infrastructure works. Approximately 300 households and several farmers were affected, one family was temporarily evacuated due to rising water from the Essequibo River. Region 4 (Georgetown area) experienced flash floods that affected eight households. Region 5 (Mahaica-Berbice) and Region 9 (Rupununi) reported river overtopping and widespread inundation, cutting off access roads and bridges.

6.16 The Nappi station recorded 240 mm of rain in 24 hours on May 28–29, one of the highest totals for the year, while severe thunderstorms and wind damage on September 26 in Region 10 caused roofs to be torn off buildings, power lines damaged, and fallen trees. Flooding of up to 18 inches inside homes, displaced several families. Additional wind damage was reported in Regions 7 and 9 in late October and early November. Hurricane Beryl's outer feeder also bands brought 40–60 mm of rainfall to eastern Guyana (Regions 5–6) but no direct impacts.

6.17 **Jamaica:** Mr. Rohan Brown presented an overview of the 2024 hurricane season impacts on Jamaica, highlighting three major systems—Hurricanes Sarah, Raphael, and Beryl—with Hurricane Beryl being the most devastating. Hurricane Beryl, a Category 4 hurricane, passed just south of Jamaica, with its northeastern quadrant bringing severe impacts to the southwestern parishes of Clarendon, Manchester, St. Elizabeth, and Westmoreland. Wind speeds reached up to 220 km/h, causing widespread destruction, including extensive damage to homes, businesses, and infrastructure. Approximately 60,000 people were displaced, with four fatalities reported due to preventable circumstances.

6.18 Major hazards included flooding, storm surges, landslides, fallen trees, and prolonged power outages—with some areas losing electricity for up to two months, severely impacting productivity and

recovery efforts. Preliminary economic losses were estimated at JMD 28.1 billion, with significant impacts to:

- Agriculture: JMD 5.7 billion (JMD 4.3 billion in crops and livelihoods)
- Education: 209 schools damaged, totaling JMD 2 billion
- Health sector: JMD 1.8 billion in damages.

6.19 **Montserrat;** Mr. Joseph Irish of Montserrat informed the meeting that Tropical Storm Ernesto was the only notable weather event affecting the island in 2024. Tropical Storm Ernesto (13 August 2024) slowed before impacting Montserrat, producing minor damages. Northern areas experienced weaker winds, while the southern regions saw the stronger gusts. Rainfall recorded reached a maximum of 9.5 mm (3.13 inches) while slightly rough seas affected a vessel docked at Port Little Bay harbour. Physical impacts included minor flooding in a few areas, uprooted trees and land slippage/rock fall in hilly regions (Bellum Valley, Happy Hill, Woodland areas) and small bridge breach occurred in Happy Hill/Bellum Valley.

6.20 **Saint Lucia:** Ms. Vigil Saltibus presented an overview of Saint Lucia's 2024 wet season, focusing on the impacts of Hurricane Beryl and subsequent rainfall events. She informed the meeting that Category 5 Hurricane Beryl, produced maximum gusts of 74 knots (83 mph) across Saint Lucia, bringing severe seas, coastal flooding, and wind damage, particularly along the west coast. The hurricane accounted for 42% of July's total rainfall at George Charles Airport, with 105 mm (4 inches) recorded.

6.21 Although the system's centre passed south of the island, feeder bands generated heavy rainfall and rough seas, leading to flooding, coastal erosion, and property damage, including impacts to electrical infrastructure—about 30% of the power network was temporarily downed. Total economic losses were estimated at USD 7.1 million, with no fatalities or injuries reported. In addition to Beryl, multiple tropical waves, surface troughs, and ITCZ activity between August and November produced frequent flooding, landslides, and infrastructure damage—especially in flood-prone areas such as Dennery, Castries, and Laborie. Notably, a tropical wave on July 6–7 generated severe lightning that disrupted telecommunication services for up to a week.

6.22 **St Vincent and the Grenadine** experienced a highly active and challenging 2024 wet season marked by the passage of Hurricane Beryl, several extreme rainfall events, flooding, landslides, severe marine conditions, and record-breaking heat. Hurricane Beryl, which developed rapidly from a tropical wave identified on June 25, became a tropical depression by June 28 and strengthened to a tropical storm later that evening before undergoing explosive intensification.

6.23 By June 29, St. Vincent and the Grenadines was placed under a hurricane watch and later a hurricane warning as Beryl approached as a major system. The hurricane brought destructive winds, severe coastal impacts, and widespread disruption, with the southern Grenadines—especially Union Island, Palm Island, PSV, Mustique, Canouan, and Bequia—bearing the brunt of the damage.

6.24 Observed winds included sustained speeds of 52–60 mph at Argyle and Bequia with gusts up to 102 mph, while Hurricane Hunter aircraft recorded wind fields near 150 mph over the southern Grenadines. Rainfall ranged from 22–112.5 mm, and marine conditions were extreme, with seas reaching 4–8 metres and causing heavy coastal erosion, damage to vessels, and at least one vessel remaining unaccounted for.

6.25 Approximately 1,362 people sought shelter and around 700 were evacuated from Union Island. Six fatalities were confirmed, a relatively low number attributed to early and accurate warnings, strong interagency coordination, and increased public readiness. Overall, Beryl's impact was severe and historic, marking one of the most destructive events in recent memory for the southern Grenadines.

6.26 Following Beryl, additional systems—including ITCZ activity, troughs, and localized mountain rainfall—produced repeated flash flooding, river overflows, and landslips across multiple communities, particularly Bequia, Calliaqua, Greggs, Stubbs, and Murray's Village. November alone delivered more than 120 mm of rainfall in a single night and further events that strained already saturated soils.

6.27 The season was also characterized by exceptional heat, with October breaking historic temperature records and contributing to a dengue outbreak that escalated through mid-year. Despite challenges such as limited staffing, communication outages, and model uncertainties, strong regional collaboration, improvements to the monitoring network, and increased public responsiveness significantly enhanced early-warning effectiveness. Looking ahead, continued strengthening of observational infrastructure, expanded staff capacity, impact-based forecasting, and enhanced public education—especially for vulnerable groups—remain critical to improving preparedness and resilience as climate extremes intensify.

6.28 **Trinidad and Tobago:** Mr. Shakeer Baig informed the meeting that Trinidad and Tobago's 2024 hurricane season was primarily impacted by Tropical Cyclone Beryl, which tracked through the eastern Caribbean. While the country was not directly hit, both Trinidad and Tobago experienced notable weather effects, particularly in Tobago. He mentioned that on 28 June, Tropical Depression II formed and Tobago and Grenada were in the cone of uncertainty. By 11 pm on June 28 June Tropical Depression II strengthened into Tropical Storm Beryl and at 5 pm on 29 June Beryl intensified into a hurricane.

6.29 On 30 June Beryl reached Category 3 hurricane, prompting tropical storm and hurricane warnings for Trinidad and Tobago. On 30 June, at 5 PM Beryl was a Category 4 hurricane, with escalated warnings for both islands. On July 1, Beryl moved into the eastern Caribbean Sea, reducing direct threat to Trinidad and Tobago. Impacts in Trinidad and Tobago included heavy wind and rainfall that affected communities such as Charlottesville and Speyside, in Tobago causing damage to power lines, landslides, and storm surges. In Trinidad persistent rainfall led to flash floods in urban and eastern/northern areas, including Mayaro. There were some fallen trees but no significant lightning impacts reported to electrical grid.

6.30 **Turks and Caicos:** Dr. Holly Hamilton presented an overview of the 2024 hurricane season, highlighting the rapid development and impact of Hurricane Oscar and the continued evolution of national weather communication and preparedness efforts. Hurricane Oscar (October 19–20) rapidly intensified from a tropical disturbance to a Category 1 hurricane east of the Turks and Caicos within hours. Grand Turk and South Caicos experienced hurricane-force winds, while the rest of the archipelago faced tropical storm conditions. Rainfall recorded was between 1–2 inches across most areas, with up to 4 inches in South Caicos, leading to localized flooding. Damage included minor structural and vegetation impacts, including fallen branches and temporary power outages. No fatalities or injuries were reported. Prior to Hurricane Oscar's formation, the islands experienced strong wave activity and minor coastal impacts associated with passing tropical disturbances.

6.31 **French Territories (Martinique, Guadeloupe, Saint-Barthélemy, Saint-Martin):** Mr. Emmanuel Cloppet, Regional Director of Météo-France, French West Indies and French Guyana, and head of RFSF Martinique, informed the meeting that the first significant event of the 2024 rain season for French territories was a hurricane Beryl. Martinique was the French territory that most impacted, especially by very strong swells, the worst swell episode of the last 10 years, with very significant impact on the coastline, especially the Caribbean coastline. The country also experienced quite a lot of rainfall between 100 and 150 millimeters in Martinique, and tropical storm winds over the territory but there were no major impacts for French territories.

6.32 The second significant event was a tropical storm Ernesto, which directly hit Guadeloupe, but the main concern was rainfall because it was a very weak tropical storm. Guadeloupe experienced nearly 200 millimeters of rain over three hours also tropical storm winds. Regarding Saint-Barthélemy and Saint-Martin, the main concern was wind because Ernesto quickly intensified between Guadeloupe and Saint-Martin and 73 knots were recorded on both islands. Damage included fallen trees.

6.33 There were also noteworthy events, especially in September, when long duration heavy rainfall events occurred in both Martinique and Guadeloupe from 6 of September to 14 September. The peak of the rainfall episode was 9 September, with more than 100 millimeters of rainfall over three hours. This caused landslides, flooded roads, flooded communities, and falling trees. There was also a heavy rainfall event on 26 September, due to a strong tropical wave passing through Martinique and Guadeloupe, with nearly 200

millimeters of rainfall recorded in Guadeloupe and 150 millimeters in Martinique, which led to mudslides, flash floods, and blocked roads.

6.34 Later in the month, the country was significantly threatened by Hurricane Tammy, which made landfall on the island of Barbuda as a category 1 hurricane on the night of 22 October 2023, with sustained winds of 92 mph, a peak gust of 114 mph, and close to 5 inches of rainfall. There were instances of flooding and damage to trees and utility lines that knocked out electrical power on the island of Barbuda.

6.35 **Common Best Practices, Challenges, Lessons Learned, Responses, and Recommendations – 2024 Severe Weather Season**

6.30 The 2024 severe weather season across the Caribbean was characterized by a series of impactful events, including multiple tropical storms, hurricanes, flood episodes, and extreme heat events. Despite variations in scale and geography, common patterns emerged among Member States and Territories regarding preparedness, forecasting, communication, and operational response. The following summarizes the key best practices, challenges, and emerging lessons to guide future regional resilience and coordination efforts.

6.31 **Common Best Practices:**

1. **Enhanced Forecasting and Early Warning Capabilities**
    - Improved use of impact-based forecasts, early advisories, and consistent collaboration with regional centres (e.g., NHC, CMO, Meteo-France).
    - Effective integration of Common Alerting Protocol (CAP) systems and expanded automatic weather station networks in several territories.
    - Use of regional models and shared expertise strengthened the accuracy and timeliness of alerts.
2. **Stronger Inter-Agency Coordination and Collaboration**
    - Closer operational coordination between Meteorological Services, Disaster Management Agencies, and Government Communication Units ensured consistent messaging.
    - Regular situation updates, interagency briefings, and shared forecast discussions improved national preparedness and response.
3. **Improved Public Communication and Outreach**
    - Adoption of WhatsApp broadcast channels, Facebook pages, and radio updates provided rapid and accessible communication with the public.
    - Clearer and more user-friendly language in advisories increased public understanding of risk.
    - Focus on hazard- and impact-based messaging (rather than storm names or categories) improved behavioural response in several countries.
4. **Capacity Building and Institutional Strengthening**
    - Ongoing training, partnerships, and new technical infrastructure projects (e.g., radar installation in Cayman, new modelling tools, and staff recruitment in French territories) continue to strengthen national meteorological capabilities.

Common Challenges

1. **Rapid System Development and Limited Lead Time**

- Sudden intensification of storms such as Hurricane Oscar and Hurricane Beryl reduced preparation windows and created high communication pressure.
- Model uncertainties continue to limit the precision of rainfall and convective event forecasts.

2. **Communication Gaps and Public Perception**
    - Fast-changing weather conditions led to occasional delays or inconsistencies in updates, especially during weekends or outside peak office hours.
    - Public response remains heavily influenced by storm names and categories, resulting in last-minute panic or early complacency.
3. **Cultural and Behavioural Barriers to Preparedness**
    - Widespread belief that the hurricane threat ends after September undermines late-season readiness (e.g., in Turks & Caicos).
    - Continued need for year-round awareness campaigns emphasizing that systems can form at any time.
4. **Limited Human and Technical Resources**
    - Many services continue to operate with small staff complements, restricting 24-hour coverage during multiple concurrent events.
    - Equipment damage (e.g., radar in Guyana) and inconsistent real-time data access reduced forecasting capacity.
5. **Misinformation and Competing Sources**
    - The spread of unofficial forecasts and social media speculation caused confusion and public distrust.
    - Some national broadcasters and private entities disseminated unverified information from external agencies.
6. **Forecasting and Modelling Limitations**
    - Persistent challenges in accurately predicting localized heavy rainfall and flash flooding, even with advanced models, remain a major operational issue.

Key Takeaways and Strategic Priorities for 2025

- Sustain and expand impact-based forecasting and strengthen national early warning systems.
- Develop coordinated, multi-agency communication frameworks to ensure rapid, authoritative public messaging.
- Invest in staff training, data access, and observation networks to improve local forecasting autonomy.
- Institutionalize year-round public education campaigns to promote preparedness beyond traditional peak months.
- Combat misinformation through trusted voices, consistent branding of official products, and enhanced public trust in local meteorological authorities.
- Leverage regional partnerships (CMO HQ, CIMH, CRIF, NHC) for resource-sharing, technical development, and research collaboration.

6.32 In totality, the 2024 season reaffirmed both the increasing meteorological complexity of Caribbean weather systems and the growing maturity of regional response mechanisms. Through strong collaboration, improved technology, and public outreach, national services effectively mitigated impacts, but persistent challenges—resource limitations, misinformation, and climate-driven hazard variability—underscore the need for continued investment in resilience and forecasting capacity.

6.33 The season also highlighted both significant progress and persistent gaps in the region's approach to weather forecasting, communication, and public preparedness. The collective experience underscores the importance of maintaining vigilance throughout the year, building trust in national meteorological services, and investing in people, data, and systems to strengthen the Caribbean's climate resilience and disaster risk management capacity.

6.34 Key lessons learned included, Rapid storm intensification demands faster information flow and greater readiness at all alert levels., public trust and understanding of official advisories remain essential to effective risk reduction, regional data sharing, joint training, and model improvement are critical to enhancing early warning reliability and Continuous public education, institutional resilience, and infrastructure hardening remain long-term priorities.

SCIENTIFIC PRESENTATIONS & NEW SERVICES DEVELOPED

(Agenda Item 7)

A. Integration of WARF-based PM2 into Operations at the Barbados Meteorological Service

7.1 Ms. Tandria Mapp of the Barbados Meteorological Service presented on the integration of the WMO-developed Plug-and-Run Model (PN-Tool), a simplified WRF-based numerical weather prediction tool, into the operations of the Barbados Meteorological Service (BMS). The PN-Tool enhances forecasting capacity by allowing greater accessibility to modelling processes, promoting staff engagement, and supporting the Early Warning for All initiative.

7.2 She outlined the history of WRF modelling at BMS, current resolutions (ranging from 800 m to 4 km), and steps taken after the regional training conducted by the CMO HQ and WMO in Trinidad to implement the tool at the BMS. Key activities included domain setup, Linux-based execution, and troubleshooting installation challenges such as script bugs, file errors, and server configuration issues. Despite these hurdles, the experience strengthened in-house technical capacity and problem-solving skills at the BMS.

7.3 Ms. Mapp demonstrated to the meeting, a case study comparing the PN-Tool outputs with radar data from October 2, 2024, indicating promising alignment of the model output with the radar's rainfall timing and intensity, thus validating the tool's potential for improving short-term forecasting accuracy**.**

7.4 Looking ahead, the meeting was informed that the BMS aims to:

- Use the PN-Tool for real-time simulations**,** impact-based forecasting**,** and tropical cyclone tracking**.**
- Integrate global models and data assimilation for enhanced precision.
- Develop an internal training programme to build staff expertise.
- Collaborate with WMO and regional partners for continued training and capacity building.

7.5 Ms. Mapp concluded by emphasizing the importance of adequate computing resources**,** staff training**,** and regional collaboration to fully leverage the PN-Tool's potential and stated that the initiative represents a significant step toward strengthening forecasting resilience and climate preparedness in Barbados and across the Caribbean.

B. Integration of the Belize Surface Climate Data Management System into the operations of CMO Member States (delivered by Dwayne Scott National Meteorological Service of Belize)

7.6 The Meeting heard a presentation from Mr. Dwayne Scott from the National Meteorological Service of Belize on the integration of the Belize Surface Climate Data Management System (CDMS) into the operations of CMO Member States' NMHSs. The initiative aims to streamline data management, quality

control, and transfer to the WIS2 network, thus improving the region's data sharing and compliance with WMO standards.

7.7 Mr. Scott noted that Belize's CDMS, known as SURFACE CDMS, serves as a central data repository for both automatic weather stations (AWS) and manual observations. The system can automatically ingest, aggregate, and quality-check data, generate required WMO messages (such as GBON and SYNOP), and transmit them directly to the WIS2 box, eliminating the need for duplicate data entry.

7.8 He mentioned that over the last year, collaboration between Belize, the CIMH, and regional partners focused on adapting SURFACE for wider regional use. This includes developing data decoders to harmonize different national data formats and enabling integration with OSCAR/Surface, ensuring metadata compliance and facilitating station registration through secure tokens.

7.9 Mr Scott informed the meeting that in November 2024, a virtual training session was held with 38 participants from 17–18 regional countries. The training covered database installation, data flow setup, and practical exercises for connecting to the regional WIS2 box. Further, ongoing support is provided through a WhatsApp group with regular updates. He outlined a timeline for implementation of SURFACE as follows:

- Nov 2025–Apr 2026: Testing and troubleshooting by participating countries.
- Jan 2026: Release of a beta version incorporating feedback.
- Before Jun 2026: Planned in-person regional training workshop.
- Jun 2026: Full operational deployment with user manual.

7.10 Mr. Scott also highlighted ongoing collaboration with the UK Met Office, which is providing development funding, and participation in WMO expert task teams on data model and API standardization to ensure that Surface remains compliant with emerging global standards. He emphasized that the project, while led by Belize, is designed to benefit the entire Caribbean region, strengthening capacity for consistent, efficient, and interoperable climate and weather data management.

C. QMS as a key component of safety management and its link to State Safety Oversight Program (delivered by Mr. Luis Raúl Sánchez Vargas, Regional Officer, Aeronautical Meteorology and Environment, ICAO Regional Office of ICAO)

7.11 Directors were also shown a method of implementing the WIS2.0box as a standalone case from a national Mr. Luis Raúl Sánchez Vargas, Regional Officer, Aeronautical Meteorology and Environment, ICAO Regional Office of ICAO delivered a presentation on the role of Quality Management Systems (QMS) as a key component of Safety Management and its integration within the State Safety Oversight Programme (SSP). He stated that ICAO's efforts focus on establishing global standards, conducting compliance audits, and providing technical assistance through its regional offices.

7.12 The presentation highlighted three core pillars of aviation safety:
1) State Safety Programme (SSP): Defines national safety policies and objectives.
2) Safety Management System (SMS): A systematic approach for service providers to manage safety risks.
3) State Safety Oversight (SSO): Ensures compliance with international and national safety regulations.

7.13 Mr. Sanchez informed the meeting of ICAO's Universal Safety Oversight Audit Programme (USOAP), which continuously monitors states' adherence to international safety standards through evidence-based assessments using standardized Protocol Questions (PQs). These audits help identify areas for improvement and guide technical assistance efforts. He underscored the role of QMS in supporting both SMS and SSO by ensuring consistency, compliance, and continual improvement in aviation services—particularly within meteorological (MET) services. Key aspects of QMS such as quality assurance (preventing defects) and quality control (detecting defects) directly contribute to operational safety and efficiency.

7.14 Mr. Sanchez pointed out to the meeting that ICAO's audit focus areas included:

1) Compliance with Annex 3 technical specifications for forecasts and observations.
2) Staff qualifications and competency in line with WMO standards.
3) Regular inspection and calibration of aeronautical meteorological equipment.

7.15 The meeting was informed that safety management safeguards aviation through proactive risk identification and mitigation, effective oversight and evidence-based evaluation strengthen state safety capabilities, a robust QMS underpins compliance, consistency, and high-quality service delivery and strengthened QMS and oversight mechanisms enhanced operational efficiency and aviation safety across the Caribbean and Central American regions. Mr. Sanchez concluded by noting that USOAP activities will intensify in the coming years, providing more frequent evaluations and opportunities for regional capacity building.

OTHER MATTERS
(Agenda Item 8)

A. *Basic Building Blocks for Meteorological Services for Aviation – A Preamble to GREPECAS Discussions*

7.1 The meeting was provided with a second presentation by Mr. Luis Sánchez of ICAO on the Basic Building Blocks (BBBs) framework for aeronautical meteorological services within the Global Air Navigation Plan (GANP), a key ICAO initiative guiding the development of air navigation services in the Americas and Caribbean. The BBBs define the essential meteorological services required for aviation—such as METARs, TAFs, and SIGMETs—and link them directly to ICAO Annex 3 provisions and associated standards and recommended practices (SARPs).

7.2 The Meeting was informed that the GREPECAS (Planning and Implementation Regional Group for the Caribbean and South America) meetings serve as a high-level forum to review the implementation and verification of these essential services. Regional implementation currently averages around 64%**,** indicating both progress and existing challenges in meeting Annex 3 compliance and quality management requirements.

7.3 Mr. Sánchez discussed the verification process under development to assess compliance with ICAO provisions and noted the need for collaboration between civil aviation authorities, meteorological authorities, and service providers to ensure effective oversight. A new dashboard tool is being created to track implementation status and guide targeted assistance to states.

7.4 He also introduced the MET Task Force, a collaborative mechanism supporting training and clarification of regulatory requirements, with upcoming webinars in 2025 to assist states in adopting the verification process. In discussion, participants explored the implications of AI and automation in aviation meteorology, where Mr. Sánchez and other panellists emphasized the importance of maintaining human oversight and accounting for regional data limitations before large-scale AI adoption.

7.5 Finally, Mr. Sánchez clarified forthcoming Annex 3 Amendment 82**,** which will refine the distinction between Meteorological Authorities and Service Providers without eliminating cost-recovery mechanisms, provided appropriate national arrangements are established. His presentation underscored ICAO's commitment to strengthening aviation meteorological services through standardization, collaboration, and oversight capacity-building across the region.

B. Exhibitors Session

7.6 For the second continuous year, the CMO Headquarters offered exhibitors to exhibit meteorology-related instruments and systems during DMS2024 and the first day of CMC67. Only one exhibitor, Campbell Scientific Instruments accepted the offer in 2024.

7.7 The strategic goal of the exhibits at DMS continue to be to provide awareness and networking in support of the goals of RBON, GBON, SOFF, and QMS. Directors of Meteorological Services and industry professionals were able to meet and engage in meaningful conversations with instrument vendor.

7.8 The exhibitors' session provided an opportunity for vendors to showcase products or services to Directors in a focused and personalized setting. This targeted interaction optimized break periods, lunch time, and closed-sessions; connecting Directors with potential vendors to have one-on-one conversations, raised awareness of regional meteorological equipment and service providers, and enhanced opportunities to build relationships.

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ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES **Doc. 1(a)**
TORTOLA, VIRGIN ISLANDS (UK), 20 NOVEMBER 2024

PROVISIONAL AGENDA

1. INTRODUCTION AND ADOPTION OF AGENDA
2. STATUS OF ACTIONS FROM THE PREVIOUS MEETING
3. TRAINING
4. OPERATIONAL MATTERS
   a) Early Warning for All Implementation
   b) Strengthening Service Capacity, including Marine and Ocean Services
   c) WIGOS Implementation: OSCAR/Surface, Regional WIGOS Centre, Global Basic Observation Network (GBON), and the associated Systematic Observation Financing Facility (SOFF)
   d) WIS 2.0 Operational Phase
   e) State of the Climate Reports
   f) Business Continuity Management
5. OUTCOME/HIGHLIGHTS FROM WMO TECHNICAL COMMISSIONS & THE 78th SESSION OF THE EXECUTIVE COUNCIL
   a) Regional Basic Observation Network (RBON)
   b) WMO Integrated Processing and Prediction System (WIPPS)
   c) Climate monitoring and early warning systems
   d) Global Greenhouse Gas Watch
   e) WMO Radio Frequency Coordination to Protect Bands vital for Weather and Climate
   f) Tropical Cyclone Competency Framework
6. IMPACTS OF THE WEATHER IN 2024 (LOSS & DAMAGE), CHALLENGES & BEST PRACTICES
7. SCIENTIFIC / INNOVATION PRESENTATIONS
8. OTHER MATTERS

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ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES
TORTOLA, VIRGIN ISLANDS (UK)

20 NOVEMBER 2024

LIST OF DELEGATES

ANGUILLA

Jeffrey Jennings
Senior Officer
Anguilla Airport Authority
ANGUILLA
Tel: 1-264-476-6302
Email: **Jeffrey.jennings<at>aspa.ai**

ANTIGUA & BARBUDA

Dale Destin
Director
Antigua and Barbuda Meteorological Service
V. C. Bird International Airport
ANTIGUA & BARBUDA
Tel: 1-268-764-5030
Email: **dale.destin<at>ab.gov.ag**

BARBADOS

Brian Murray
Deputy Director
Barbados Meteorological Service
CAD Building, Charnocks
Christ Church
BARBADOS
Tel: 1-246-233-6424
Email: **Brian.Murray<at>barbados.gov.bb**

Tandria Mapp
Meteorologist
Barbados Meteorological Service
CAD Building, Charnocks
Christ Church
BARBADOS
Tel: 1-246-233-6424
Email: **tandria.mapp<at>barbados.gov.bb**

BELIZE

Ronald Gordon
Chief Meteorologist
National Meteorological Service
Phillip Goldson International Airport
Ladyville
BELIZE
P.O. Box 717
Tel: 011 -501-621-1046
Email: **chief<at>nms.gov.bz**

Dwayne Scott
Electronic Technician
National Meteorological Service
Phillip Goldson International Airport
Ladyville
BELIZE
P.O. Box 717
Tel: 011 -501-621-8969
Email: **dscott<at>nms.gov.bz**

BRITISH VIRGIN ISLANDS

Elvia Smith-Maduro
Permanent Secretary
33 Admin Drive
Wickhams Cay Drive 1
Road Town, Tortola
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-9629
Email: **esmith-maduro<at>gov.vg**

Jasen Penn
Director
Disaster Management – Office of the Governor
#3 Wailing Road
Road Town, Tortola
VIRGIN ISLANDS (BRITISH)
VG1110
Tel: 1-284-468-9665
Email: **japenn<at>gov.vg**

Kurt Menal
Managing Director
British Virgin Islands Airport Authority
Terrance B. Lettsome International Airport
Beef Island
Road Town, Tortola
VIRGIN ISLANDS (BRITISH)
VG1110
Tel: 1-284-499-1889
Email: **kmenal<at>bviaa.com**

BRITISH VIRGIN ISLANDS CONT'D

Phil DaSilva
Manager
British Virgin Islands Airport Authority
Terrance B. Lettsome International Airport
Beef Island
Road Town, Tortola
VIRGIN ISLANDS (BRITISH)
VG1110
Tel: 1-784-492-6192
Email: **kcummings<at>bviaa.com**

Kyle Cummings
Director of Operations
British Virgin Islands Airport Authority
Terrance B. Lettsome International Airport
Beef Island
Road Town, Tortola
VIRGIN ISLANDS (BRITISH)
VG1110
Tel: 1-284-340-3074
Email: **kcummings<at>bviaa.com**

CAYMAN ISLANDS

John Tibbetts
Director-General
Cayman Islands National Weather Service
88A Owen Roberts Dr.
George Town
Grand Cayman
CAYMAN ISLANDS
Tel: 1-345-925-8548
Email: **john.tibbetts<at>gov.ky**

DOMINICA

Ithoma James
Senior Meteorologist
Dominica Meteorological Service
Ministry of National Security & Legal Affairs
21 Kennedy Ave, Roseau
DOMINICA
Tel: 1-767-266-4440
Email: **ithomajames<at>gmail.com**

GRENADA

Gerard Tamar
Manager of Meteorology
Grenada Airports Authority
Point Salines, St.George's

GRENADA
Tel: 1-473-405-3370
Email: **gtamar<at>gaa.gd**

Jude Andre Charles

Assistant manager of Meteorology
Grenada Airports Authority
Point Salines, St.George's
GRENADA
Tel: 1-473-534-5611
Email: **acharles<at>gaa.gd**

GUYANA

Dr Garvin Cummings

Chief Hydrometeorological Officer
Hydrometeorological Service of Guyana
18 Brickdam
STABROEK
GUYANA
Tel: 001-592-626-1669
Email: **cho<at>moa.gov.gy**

Satesh Nanlall

Meteorologist
Hydrometeorological Service of Guyana
18 Brickdam
STABROEK
GUYANA
Tel: 001-592- 679-9348
Email: **SateshNanlall_2K9<at>yahoo.com**

Eron McPherson

Meteorologist
Hydrometeorological Service of Guyana
18 Brickdam
STABROEK
GUYANA
Tel: 001- 592-647-6660
Email: **meteorologist.eron<at>gmail.com**

Komalchand Dhiram

Meteorologist
Hydrometeorological Service of Guyana
18 Brickdam
STABROEK
GUYANA
Tel: 001- 592-658-0761
Email: **kdhiram2015<at>gmail.com**

GUYANA CONT'D

Haymawattie Danny

Deputy Chief Hydrometeorological Officer
Hydrometeorological Service of Guyana
18 Brickdam
STABROEK
GUYANA
Tel: 001- 592-648-1862
Email: **haymadanny<at>gmail.com**

JAMAICA

Rohan Brown

Meteorological Service of Jamaica
65 3/4 Half-Way-Tree Road
Kingston 10
JAMAICA
Tel:
Email: **rohan.brown<at>megjc.gov.jm**

MONTSERRAT

Joseph Irish

Airport Manager
John A Osborne Airport
Gerald's
MONTSERRAT
Tel: 1-664-495-1572
Email: **irishjl<at>gov.ms**

SAINT LUCIA

Lenitia Joseph

Permanent Secretary
Department of Infrastructure, Ports & Transport
Union Complex, Castries
SAINT LUCIA
Tel: 1-758-733-0162
Email**:** **ljoseph<at>gosl.gov.lc**

Vigil Saltibus

Meteorologist
Saint Lucia Meteorological Services
Union, Castries
SAINT LUCIA
Tel: 1-758-729-2490
Email**:** **vigil.saltibus<at>govt.lc**

ST KITTS & NEVIS

Elmo Burke

Senior Meteorological Officer
St. Christopher Air & Sea Ports Authority (SCASPA)
Bird Rock, Basseterre
ST KITTS & NEVIS
Tel: 1-869-662-3247
Email: **elmo.burke<at>scaspa.com**

Denel Dixon

Meteorological Officer/ Forecaster
St. Christopher Air & Sea Ports Authority (SCASPA)
Bird Rock, Basseterre
ST KITTS & NEVIS
Tel: 1-869-760-2702

Email: **denel.dixon<at>scaspa.com**

ST VINCENT & THE GRENADINES

Gregory Cato

Forecaster
Saint Vincent and the Grenadines Meteorological Services
Ministry of National Security
Argyle International Airport
ST. VINCENT & THE GRENADINES
Tel: 1-784-491-3026
Email: **manager.metservices<at>gov.vc**

TRINIDAD & TOBAGO

Shakeer Baig

Director
Trinidad & Tobago Meteorological Service
P.O. Box 2141 National Mail Centre
Piarco
TRINIDAD & TOBAGO
Tel: 1-868-494-3206
Email: **DirMetTT<at>gov.tt**

TRINIDAD & TOBAGO CONT'D

Kimberly Seaton

ICT Officer
Trinidad & Tobago Meteorological Service
P.O. Box 2141 National Mail Centre
Piarco
TRINIDAD & TOBAGO
Tel: 1-868-719-5539
Email: **kimberly.seaton<at>metoffice.gov.tt**

TURKS & CAICOS ISLANDS

Dr Holly Hamilton

Director of Meteorology
Turks and Caicos Islands Airport Authority
National Weather Service
Providenciales
TURKS & CAICOS ISLANDS
Tel: 1-649-441-4466
Email: **hollyhamilton<at>tciairports.tc**

INSTITUTIONS/ORGANIZATIONS

BAHAMAS DEPARTMENT OF METEOROLOGY

Jeffrey Simmons
Director
#10 Airport Industrial Park
Nassau
Bahamas
Tel: 1-242-357-3391
Email: **jeffreywsimmons<at>gmail.com**

CARIBBEAN INSTITUTE OF METEOROLOGY & HYDROLOGY (CIMH)

Dr David Farrell
Principal
Husbands, St. James
BARBADOS
Tel: 1-246-231-3456
Email: **principal<at>cimh.edu.bb**

Cheryl Joyette
Senior Administrative Officer
Husbands
St. James
BARBADOS
Tel: 1-246-244-3438
Email: **cjoyette<at>cimh.edu.bb**

Christine Griffith
Administrative Assistant
St. James
BARBADOS
Tel: 1-246-244-3438
Email: **cgriffith<at>cimh.edu.bb**

Karen Forte
Executive Assistant to the Principal
Husbands, St. James
BARBADOS
Tel: 1-246-289-0339
Email: **kforte<at>cimh.edu.bb**

Kathy-Ann Caesar
Lecturer
Husbands, St. James
BARBADOS
Tel: 1-246-289-0339
Email: **kforte<at>cimh.edu.bb**

CARIBBEAN METEOROLOGICAL ORGANIZATION HEAD QUARTERS UNIT

Dr Arlene Laing

Coordinating Director
#27 O'Connor Street, Woodbrook
PO Box 461, Port of Spain, 170513
TRINIDAD & TOBAGO
Tel: 1-868-622-4711
Fax: 1-868-622-0277
E-mail: **ALaing<at>cmo.org.tt**

Kenneth Kerr

Science and Technology Officer
#27 O'Connor Street, Woodbrook
PO Box 461, Port of Spain, 170513
TRINIDAD & TOBAGO
Tel: 1 868 622 4711
Fax: 1 868 622 0277
E-mail: **kkerr<at>cmo.org.tt**

Natalie Araujo-O'Brien

Finance and Administrative Officer
#27 O'Connor Street, Woodbrook
PO Box 461, Port of Spain, 170513
TRINIDAD & TOBAGO
Tel: 1-868-622-4711
Fax: 1-868-622-0277
E-mail: **Naraujo-OBrien<at>cmo.org.tt**

Haley Anderson

Project Development Officer
#27 O'Connor Street, Woodbrook
PO Box 461, Port of Spain, 170513
TRINIDAD & TOBAGO
Tel: 1 868 622 4711
Fax: 1 868 622 0277
E-mail**:** **Handerson<at>cmo.org.tt**

DEPARTMENT OF ST MAARTEN

Joseph Isaac

Meteorological Department of St Maarten
12 Modesta Drive
ST MAARTEN
Tel: 1-721-520-3140
Email: **joseph.isaac<at>sintmaartengov.org**

International Civil Aviation Organization

Luis Sanchez
Regional Officer, Aeronautical Meteorology and Environment
North American, Central American & Caribbean Office (NACC)
Mexico City
MEXICO
Tel: 1-552-908-5581
Email: **lsanchez<at>icao.int**

METEO-FRANCE

Emmanuel Cloppet
French West Indies and Guiana Director
Météo-France Antilles Guyane Route du Général-Brosset
BP 645 Fort de France
MARTINIQUE
Tel: 1-596-696-358-548
Email: **emmanuel.Cloppet<at>meteo.fr**

UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION

Jair Torres
Programme Management Officer
Regional Office for the Americas & the Caribbean
United Nations Office for Disaster Risk Reduction (UNDRR)
United Nations House, Bridgetown
BARBADOS
Tel: 1-246-249-7638
Email: **jair.torres<at>un.org**

WORLD METEOROLOGICAL ORGANIZATION (WMO)

Rodney Martinez Guingla
Representative for North America, Central America and the Caribbean
IMH, 3rd Floor Barrio Aranjuez, San Jose
COSTA RICA
Tel: 1-506-719-5353-0
Email: **rmartinez<at>wmo.int**

WORLD METEOROLOGICAL ORGANIZATION (WMO) CONT'D

Stephanie Gallasch
Project Officer
Route de la Vignettaz 67
Fribourg
Geneva
SWITZERLAND
Tel: 1-417-822-1560
Email**:** **sgallasch<at>wmo.int**

SUPPORT STAFF

CARIBBEAN METEOROLOGICAL ORGANIZATION HEADQUARTERS UNIT

Avalon Sharpe
Secretary
#27 O'Connor Street, Woodbrook
PO Box 461, Port of Spain, 170513
TRINIDAD & TOBAGO
Tel: 1-868-622-4711
Fax: 1-868-622-0277
E-mail: **asharpe<at>cmo.org.tt**

Ministry of Works & Communications

Joy Scatliffe
Personal Secretary to the Minister
Ministry of Communications & Works
Government of the Virgin Islands
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2183
Email: **jscatliffe<at>gov.vg**

MINISTRY OF COMMUNICATIONS & WORKS CONT'D

Darlene Matthias
Records Officer
Ministry of Communications & Works
Government of the Virgin Islands
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2183

Curlyn Fahie-Hodge
Senior Executive Officer
Ministry of Communications & Works
Government of the Virgin Islands
Road Town, Tortola
VG1110

VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2183

Kadia Turnbull
Administrative Assistant
Ministry of Communications & Works
Government of the Virgin Islands
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2183

Giovoni Herbert
Information Officer
Ministry of Communications & Works
Government of the Virgin Islands
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2183

DEPARTMENT OF INFORMATION & PUBLIC RELATIONS

Jonel Lacey
Production Supervisor
RFG Edifice Building, 5th Floor
354 James Walter Francis Drive
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2730
Email: **gis<at>gov.vg**

DEPARTMENT OF INFORMATION & PUBLIC RELATIONS CONT'D

Ronnielle Fraser
Photographer
RFG Edifice Building, 5th Floor
354 James Walter Francis Drive
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2730
Email: **gis<at>gov.vg**

Linnel Stevens
Production Technician II
RFG Edifice Building, 5th Floor
354 James Walter Francis Drive
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2730
Email: **gis<at>gov.vg**

Franklyn Skerritt
Assistant Photographer
RFG Edifice Building, 5th Floor
354 James Walter Francis Drive
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2730
Email: **gis<at>gov.vg**

Alvin Bertie
Graphic Artist I
RFG Edifice Building, 5th Floor
354 James Walter Francis Drive
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2730
Email: **gis<at>gov.vg**

BVI INTERNATIONAL AFFAIRS SECRETARIAT

Dwynel Davis
Ag. Director
Premier's Office
Third Floor, Sebastian's Building
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2578
Email: **ias<at>gov.vg**

BVI INTERNATIONAL AFFAIRS SECRETARIAT CONT'D

Kareem-Nelson Hull
Protocol Officer
Premier's Office
Third Floor, Sebastian's Building
Road Town, Tortola
VG1110
VIRGIN ISLANDS (BRITISH)
Tel: 1-284-468-2578
Email: **ias<at>gov.vg**
