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

DRAFT REPORT OF THE

ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES

St. John's, ANTIGUA AND BARBUDA

15 NOVEMBER 2017

INTRODUCTION

1.1 At the kind invitation of the Government of Antigua and Barbuda, the 2017 Meeting of Directors of Meteorological Services was held at the Starfish Jolly Beach Resort, Bolans Village in Antigua on Wednesday 15 November 2017, under the Chairmanship of Mr Tyrone Sutherland, Coordinating Director of the Caribbean Meteorological Organization (CMO).

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

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

STATUS OF ACTIONS FROM THE PREVIOUS MEETING

(Agenda Item 2)

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

2.2 In this regard, a summary of the decisions of DMS2016 (Grenada, 2016) was prepared by the CMO Headquarters. The Science and Technology Officer gave the status of actions taken to implement the decisions to the Meeting. There were three items within the status of actions from 2016 which were highlighted, these were:

1. The need for National Meteorological and Hydrological Services (NMHSs) to create a training plan for at least a duration of five (5) years which could inform CIMH and WMO of their training needs;
2. The creation of a National Satellite Training Plan by NMHSs to identify their training needs and a timeframe for completion;
3. NMHS must nominate WIS and WIGOS focal points and ensure that the focal points complete the review and update of the country's metadata on the GISC portal and OSCAR/Surface.

2.3 Based on the responses from the **Director** of the **Trinidad and Tobago Meteorological Service** and the **Director** of the **Antigua and Barbuda Meteorological Services,** which were supported by the **Head of Meteorology in Grenada**, there seemed to be some misunderstanding as to what was required. Both Directors indicated that more information was needed before they could articulate their training needs. The Caribbean Meteorological Organization offered to assist all Services where possible to identify their training needs.

TRAINING
(Agenda Item 3)

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

3.2 The issue of the students having a weak background in Mathematics continued to be a problem in 2017 and this problem could be exacerbated with the UWI's movement away from 4-credit courses to 3-credit courses, where students pursuing a degree in Meteorology may have to take as many as five Mathematics courses in the new 3-credit course paradigm rather than the two courses under the 4-credit course system. A possible solution to reduce the number of Mathematics courses under the 3-credit system was being investigated and a future Meeting of the Directors of Meteorological Services (DMS) would be provided with the solution.

3.3 It was recalled that the 2016 training report highlighted that the lecturers continued to encounter students with non-academic challenges. During 2017, that situation produced students who required assistance beyond the capabilities and/or expertise of the CIMH staff. Unfortunately, there were some volatile incidences which could have been avoided if there were professional counselling services available to both students and lecturers. The presentation noted that a considerable portion of the lecturers' time was taken up in student counselling. It was strongly recommended that a counsellor should be associated with the Institute to provide the necessary services to students and lecturers.

3.4 The Meeting was informed that the Aeronautical Continuing Professional Development (AeroCPD) online course would resume in 2018 with two new courses which are (i) Introduction to the Access and Operational Use of GOES 16 imagery and (ii) Introduction of Basic Management Skills. It was noted, however, that the courses were undersubscribed, although this was a course requested by an earlier meeting of the Directors of Meteorological Services to enable the Services to meet their Quality Management System requirements. The course "*Introduction to the Access and Operational Use of GOES 16 imagery*" would enable the successful participants to acquire the necessary skills that support the WMO competencies that relate to the use of satellite data by operational meteorologists.

3.5 There were several international courses which the CIMH participated in, these included, (i) the WMO/NOAA VLab Train the Trainer Workshop on Satellite Data Usage and (ii) 2017 NOAA Satellite Conference. Further, the CIMH successfully hosted the Weather and Climate Weather-Ready Nation Project workshops, the Thirteenth WMO Education and Training Symposium (SYMET-13) and Meeting of the Directors of Regional Training Centre.

3.6 As part of its outreach efforts, the CIMH assisted secondary schools across Barbados in the delivery of the Caribbean Examinations Council (CXC) Geography syllabi at the Caribbean Secondary Education Certificate (CSEC) and Caribbean Advanced Proficiency Examination (CAPE) levels. The Geography syllabi at both levels consist of weather and climate modules which several regional Geography teachers had indicated they were not adequately prepared to teach.

3.7 The CXC had indicated that for exam years 2004-2015, the responses to meteorology questions were generally unsatisfactory. Following discussion with regional Geography teachers, Ministries of Education and CXC, CIMH proposed and instituted in 2017, an online short course to assist regional secondary school Geography teachers who wish to develop a greater understanding of the fundamentals of meteorology applicable to the CSEC/CAPE Geography syllabus. The course utilized a combination of COMET modules and other online resources along with lecture slides prepared by CIMH instructors. The Moodle and WizIQ platforms were used to facilitate course delivery. It was planned to make the course an annual summer holiday (early July to mid-August) course for teachers, offering meteorological applications and exercises for Mathematics and Physics educators to use in their course delivery at CSEC and CAPE level. The **Director** of the **Trinidad and Tobago Meteorological Service** commended CIMH for the introduction of the course but recommended that the nominal fee to participate in the course should be dropped in an effort to have geography teachers from other countries participate and that the number of participants per country be limited for the course to be effective to all participants..

3.8 The Meeting was informed that the CIMH would start the next Basic Instruction Package for Senior-Level Technicians in March 2018 and Directors were encouraged to have staff members who have BSc. Degrees in Mathematics and Physics apply to be course participants. The **Director** of the **Jamaica Meteorological Service** inquired as to the length of the course since there were members of his staff who were interested, but they did not want to be away for eighteen months. The Director was informed that the length of the course would be fifteen months and that it could not be shortened to nine months at this time, although that may be possible in the future.

3.9 A **Representative of Antigua and Barbuda Meteorological Service** enquired of CIMH as to whether they would be including a module associated with aerosols and associated health in the AeroCPD course. The Meeting was informed that it may be possible in the near future.

OPERATIONAL MATTERS
(Agenda Item 4)

4.1 The Meeting was made aware of a number of matters which were particularly related to the operations and the services delivered by Meteorological Services in the Caribbean.

A WMO Annual Global Monitoring

4.2 The Meeting noted that some Meteorological Services of the Member States that have stations in the Regional Basic Synoptic Network (RBSN) did not participate in the World Meteorological Organization (WMO) Annual Global Monitoring (AGM), which monitors the data disseminated over the Global Telecommunication Service (GTS). There are ten (10) Members States of the Caribbean Meteorological Organization whose National Meteorological Service (NMS) are RBSN stations. These are Antigua and Barbuda, Barbados, Belize, the Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Saint Lucia and Trinidad and Tobago. A perusal of the 2017 monitoring folder on WMO's FTP server on 15 November, where digital results were posted, indicated that only Antigua and Barbuda, Barbados, the Cayman Islands and Jamaica had posted results at that time.

4.3 The Meeting was also presented with the results of the 2016 AGM from WMO's data archive at **ftp://ftp.wmo.int/GTS_monitoring/AGM/To_WMO/201610/** which showed only Belize, Dominica and Jamaica submitted results of their monitoring for the AGM. The results which were presented for the monitoring of SYNOP, TEMP and CLIMAT reflected for the most part, the reports from the RTH and MTN centres and the results showed that for the SYNOP code from the thirteen (13) offices reporting from the Member States, eight (8) were within the 90-100% range, four (4) were in the 45-90% range and Barbados was silent.

4.4 All of the upper-air stations were within the 90-100% range. No CLIMAT reports were received from Barbados, Belize, Cayman Islands and Guyana during the AGM period in 2016 and they were deemed to be silent.

4.5 The **Acting Director** of the **Barbados Meteorological Service** enquired as to whether the transmission of synoptic and climate observation in BUFR format could account for the poor receipt of the observations at the RTH and MTN centres. The meeting was informed that the results would be the same whether the observations were transmitted in traditional alphanumeric form or BUFR. The **Director** of the **Trinidad and Tobago Meteorological Service** informed the Meeting that verification of the observation receipt by the RTH was part of its QMS process and as such, before an observation can be processed within its QMS system as transmitted, a particular website was visited to ensure that the observation was rebroadcast by the RTH to appear on the website.

B. Impact-Based Forecast and Warning Services

4.6 It is generally agreed that the primary responsibility of National Meteorological and Hydrological Services (NMHSs) is to provide timely and accurate forecasts and warnings of meteorological events and hazards. However, in order for governments, economic sectors and the public to take appropriate action, they need to know how the meteorological hazard would impact their lives, livelihoods, property and the economy.

4.7 It was recognized that understanding disaster risk and forecasting meteorological impacts are generally beyond the remit of meteorologists and hydrologists. In most countries, those affected are demanding more than statements of expected weather conditions from their NMHSs. The risk associated with a meteorological hazard depends on knowing how that hazard could impact human beings, their livelihoods, and assets due to their vulnerability and exposure. Hence, a paradigm shift was needed to progress from providing the meteorological forecast (what the weather will be) to the impact of a hazard (what the weather will do). Such forecasts would ensure that critical weather information was communicated about societal impacts to individuals and sectors most at risk.

4.8 The Meeting was informed that the implementation of the WMO *Strategy for Service Delivery* was an important tool for integrating impact-based forecasting and risk-based warnings into a common planning framework, in order to maximize benefits and allow for planning and maintenance of observing infrastructure. It was suggested to the Meeting that a methodology which could be used to develop a national Public Weather Service was to have national stakeholder workshops in order for stakeholders to be familiarized with the challenges and issues involved.

4.9 The **Principal** of the **CIMH** agreed that impact forecasting was difficult but the way forward was in the development of partnerships with national stakeholders. The **Director** of the **Saint Lucia Meteorological Service** suggested that CMO provide guidance to all Meteorological Services so that they progress in a united manner. The **CIMH Principal** opined that CMO as referred to by the **Director** of the **Saint Lucia** meant both the Headquarters Unit and CIMH and indicated that the Weather Ready Nation Climate Project would develop templates which would help countries develop the necessary skills in impact-based forecasting.

C. Quality Management System

4.10 The Meeting was reminded that the implementation of a quality management system (QMS) by National Meteorological Services had been a discussion point at many past meetings and the last discussion on QMS specifically for aviation was at the 2014 Meeting of Directors (Kingston, Jamaica). The 2014 Meeting of Directors of Meteorological Services was informed that the International Civil Aviation Organization (ICAO) had proposed an amendment to *Annex 3- Meteorological Service for International Air Navigation*, which would come into effect from November 2018. The proposed amendment would state:

> *2.2.6 Demonstration of compliance of the quality system applied shall be by audit. If nonconformity of the system is identified, action shall be initiated to determine and correct the cause. All audit observations shall be evidenced and properly documented*.

4.11 It was noted that the change to Annex 3, paragraph 2.2.6, would require the audits to be performed on the Meteorological Service Provider to ensure that a quality management system was established. It was the responsibility of the Meteorological Authority to ensure that its designated Meteorological Service Provider was audited. ICAO's audits focused on the safety oversight capability of the designated governmental authority responsible for civil aviation and were performed under the framework of the Universal Safety Oversight Audit Programme (USOAP).

4.12 The **Director** of the **Saint Lucia Meteorological Service** enquired as to whether there were other meteorological services outside of the Region where the Meteorological Service was both the Service Provider and the Meteorological Authority. The **Chairman** indicated that there are countries where this was so, but the ICAO was working to have them separated.

4.13 The **Head** of **Meteorology** of **Grenada** reminded the **Chairman** that a request was made by Grenada prior to the Meeting, that the Eastern Caribbean Civil Aviation Authority (ECCAA) should be invited to the meetings. The **Chairman** indicated that this had been done but there was no response. The **Head** of **Meteorology** of **Grenada** informed the Meeting that one of the fundamental responsibilities of ECCAA was to help Member States of the Organization of Eastern Caribbean States (OECS) to implement all standards and recommended practices adopted by ICAO. An appeal was made by the **Head** of **Meteorology, Grenada,** for the CMO to assist Member States of the OECS to have ECCAA carry out its responsibilities.

4.14 The **Director** of the **Antigua and Barbuda Meteorological Services** indicated that the remarks by **Grenada** are correct, but at the moment there was no Meteorological Authority for the OECS Member States and some mechanism should be used to have ECCAA fulfil its responsibilities. The **Director** of **Airports** of **St. Vincent and the Grenadines** stated that, based on the Civil Aviation Act in the OECS, which was a harmonized legalization, the Authority for Aviation without exception for Annex 1-19 was ECCAA. She read to the Meeting the preamble of the harmonized legalization of establishing the Eastern Caribbean Civil Aviation Authority, which stated:

AGREEMENT ESTABLISHING THE EASTERN CARIBBEAN CIVIL AVIATION AUTHORITY

PREAMBLE

An Agreement made on the 21st day of October, 2003 between the Governments of Antigua and Barbuda, The Commonwealth of Dominica, Grenada, Saint Christopher and Nevis, Saint Lucia, and Saint Vincent and the Grenadines (hereinafter referred to as "the Participating States").

WHEREAS it is desirable to promote aviation by establishing an autonomous regional regulatory organization for the purpose of regulating civil aviation and fostering competitiveness in the aviation industry in the Eastern Caribbean and for harmonising the application of the standards and recommended practices adopted by the International Civil Aviation Organisation (ICAO) and to the extent practicable with neighbouring Caribbean States.

4.15 The **Director** of the **Trinidad and Tobago Meteorological Service** (TTMS) provided information concerning the contents of a Letter of Agreement (LoA), which was provided by the Trinidad and Tobago Civil Aviation Authority to the TTMS for signature. The contents of the LoA complied with the requirements of ISO 9001 QMS. However, it was indicated that the implementation of the LoA would be costly to the TTMS.

4.16 The Meeting was further informed that WMO was in the process of reviewing its proposed Organization-wide approach to Quality Management Framework (QMF) and related roles of the Members, technical commissions, regional associations and the Secretariat. Some actions as it pertains to the review of the WMO QMF had already occurred and it was necessary to update the existing regulatory and guidance material (WMO-No. 49, Technical Regulations Vol. IV; WMO-No. 1001 and WMO-No. 1100) in order to align these documents with the new ISO 9001:2015, which would be in effect from September 2018.

WIGOS IMPLEMENTATION

(Agenda Item 5)

A. National WIGOS Implementation Plans

5.1 National Meteorological and Hydrological Services (NMHSs) were expected to become the key integrators at the national level, both by strengthening their own observing systems according to the regulations and guidance provided by the WIGOS framework, and by building national partnerships and providing national leadership based on their experience in the acquisition, processing and dissemination of observational data for environmental monitoring and prediction purposes.

5.2 The leadership role of NMHSs in integrated observing systems and the engagement with national partners was central to the success of WIGOS implementation. WIGOS provides an opportunity to strengthen the role of NMHSs in all aspects of their national mandates, from national coordination and exchange of observations across all relevant domains and to reinforce their status as the national meteorological and hydrological service provider of choice.

5.3 NMHSs operate in a rapidly changing environment in terms of technological advances and the increasing demand for more and more diverse services from increasingly sophisticated and capable users. To assist NMHSs to meet the increasing demand for services, it was expected that by WMO Cg-18 (2019), all Members should be "WIGOS Ready" per the Plan for the WIGOS pre-operational phase. To achieve at least the minimum expected outcomes of the pre-operational phase, NMHSs have to develop a National WIGOS Implementation Plan. All of the expected activities and indicators to be WIGOS Ready at the national level are provided in **ANNEX III**.

5.4 The **Head** of **Meteorology of Grenada** inquired about the WIGOS training and the reason why Grenada had not been invited to the training event. The Representative was informed that the meeting was held under the auspices of the WMO WIGOS Project Office and that was the reason for the non-invitation since Grenada is not a member of WMO. The Meeting was shown an example of the OSCAR/Surface portal and informed as to how the metadata should be updated. The **Acting Director** of the **Barbados Meteorological Service** informed the Meeting that the Barbados Meteorological Service had developed a National WIGOS Implementation Plan. It was suggested to the Barbados Representative that the Plan be revised with the CIMH's assistance.

B. Data Partnerships

5.5 WIGOS enables the integration of data from a diversity of observing systems into a composite set of observations to support a broad range of applications areas. These systems have historically been operated by National Meteorological and Hydrological Services (NMHSs) and established partners. WIGOS also now encourages and enables the integration of observations from NMHS and non-traditional sources, including other government organizations, non-governmental organizations, research institutions, volunteer networks, and private sector operators.

5.6 One of the aims of WIGOS is to provide a comprehensive set of reliable, authoritative and trusted observations to support improved service delivery among WMO Members. At the same time, the WIGOS framework was an opportunity to strengthen national observing systems to better support national objectives, needs and priorities.

C. Regional Basic Observation Network

5.7 The seventeenth meeting of the WMO Congress (Cg-17) decided that the development of WIGOS would continue during its pre-operational phase as one of the WMO strategic priorities in the period 2016-2019, with a focus on the regional and national implementation. As part of the regional WIGOS implementation, the Regional Basic Observation Network (RBON) was being introduced to replace the existing Regional Basic Synoptic Network (RBSN) and the Regional Basic Climate Network (RBCN) networks. Those stations which were part of the RBSN and RBCN would automatically become part of the RBON.

5.8 Corresponding standards and recommendations supported by best practices and procedures for implementation of the RBON by all regional associations were being drafted by the WMO Commission for Basic Systems (CBS) in the view to incorporate them into a new edition of the *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160) in 2019.

D. Satellite Skills and Knowledge for Operational Meteorologists

5.9 Nearly all geostationary meteorological satellite systems in the world would be replaced by a new generation of satellites in the 2015-2022 timeframe. Other new-generation systems will be deployed in polar orbit and other orbit types in the coming decade. The new generation of satellites would bring significant enhancements to satellite-based products and services delivered by NMHSs, provided that users can effectively reap their benefits. It means that ingesting the new data types in operational schemes, with overall data volumes one magnitude higher than today, would have a major impact on NMHSs' infrastructure, systems, applications and services, and would require coordinated action at the scientific, technical, financial, organizational and educational levels.

5.10 It was recommended to all concerned Members to set up user preparation projects in advance of the launches of new satellite systems. Budgeting and planning was of paramount importance and needed to be started early. The new generation satellite system can in some cases be the driver of significant infrastructure upgrades; performance requirements in terms of data acquisition, storage, network, etc. and should thus be known many years in advance in order to incorporate the necessary upgrades in the long-term evolution and investment plans of the NMHSs.

5.11 Different training subjects and different target groups for training already exist, so it was important to identify the different categories of training needed as they have different time scales and require different levels of information about the new satellite system. Generic satellite skills and knowledge for operational forecasters recommended by WMO should serve as guidance for framing training activities. The approach for organizing training depended very much on the needs and capabilities of the NMHS and on the organizational relationship between satellite operators and users. With the advancement of e-learning technology, emphasis was clearly shifting from long-term planned classroom training towards “just-in-time-training” based on webinars, self-study online training etc.

5.12 The increasing importance of continuing training activities after launch must be emphasized. The training needs to cover critical real weather situations for all seasons and it must be based on the real characteristics of the satellite systems. Emphasis should be given to training formats that can be integrated into ongoing operations; i.e., short training modules for “as it occurs” training of operational forecasters on or between shifts.

5.13 The **Director** of the **Trinidad and Tobago Meteorological Service** requested more information about the competency skills for the operational satellite meteorologist. The WMO publication *Guidelines on Satellite Skills and Knowledge for Operational Meteorologists* was provided to participants via email, as requested by the **Director** of the **Trinidad and Tobago Meteorological Service**. The **Director** further indicated that it was the metadata which must be to WMO standards and not necessarily the observation.

OUTCOME/HIGHLIGHTS OF THE SIXTY-NINTH MEETING OF WMO EXCUTIVE COUNCIL
(Agenda Item 6)

A. WIS Implementation - BUFR Migration

6.1 The Meeting of the Directors was reminded that the migration from Traditional Alphanumeric Code (TAC) of SYNOP, TEMP and CLIMAT to Table Driven Code Forms (TDCF) was to have been completed **by November 2010**. The World Weather Watch quantitative monitoring gathers information on observations received from stations in the Regional Basic Synoptic Networks (RBSNs) during the first fifteen days of January, April, July and October. A component of that monitoring is the Special Main telecommunication network Monitoring (SMM) that records the RBSN stations reported in each file or message passing through the participating centres on the Global Telecommunication System.

6.2 The Meeting was shown the results of the SMM for the period 1-15 in January and April 2017, which were not favourable for most of the Caribbean States. The **Director** of the **Antigua and Barbuda Meteorological Service** found the results presented to be inconceivable. The Meeting was reminded that RTH Washington needed to be informed of the change of reporting format before the observation could be transmitted. The Meeting tasked the **Science and Technology Officer, CMO** to investigate and resolve this issue.

B. Meteorological Services for Aviation

6.3 A recent global survey on aeronautical meteorological service provision conducted by the Commission for Aeronautical Meteorology (CAeM) highlighted, inter alia, that while NMHSs of WMO Members were still heavily involved in aeronautical meteorological service provision – at local, national, regional and/or global levels – a number of other parties were now typically involved, including air navigation service providers and commercial meteorological service providers. It was also observed that while there had been great progress in the implementation, by Members, of key initiatives including quality management systems for aeronautical meteorological service provision and competency assessment of aeronautical meteorological personnel, gaps still remained in some regions.

6.4 It was recognized that aeronautical users, including but not limited to the airlines represented by the International Air Transport Association (IATA), require more transparency and a simplification of aeronautical meteorological charges, and that this could be achieved through improved engagement between, not least, the aeronautical meteorological service provider and user communities, facilitated through WMO, ICAO and IATA. It was also recognized that, on occasion, the costs recovered from aviation did not always make their way back to the service provider(s), often due to the arrangements within a Member State, with consequent ramifications on the ability of the service provider(s) to deliver and further develop their services.

6.5 In respect of aviation safety, the Sixty-ninth meeting of the WMO Executive Council (2017) was informed that hazardous meteorological conditions continue to be a significant factor in aviation incidents and accidents at airports and in the air. It was noted that the rapid advancement in the methods of disseminating meteorological information to the flight deck, including increased use of computer tablets, was also now influencing how users were undertaking flight crew training in meteorology. It was further noted, for example, that the pilots are now harnessing the power of new technologies and that, as a consequence, the traditional means of obtaining pre-flight briefing materials and in-flight updates were likely to become outdated sooner rather than later.

6.6 The WMO Executive Council urged Members to conduct a thorough SWOT (strengths, weaknesses, opportunities, threat) analysis of their NMHSs, and to consider developing their own plans, taking into account national stakeholder requirements for aeronautical meteorological service provision, global and regional plans and trends.

C. Public Weather Services

6.7 It was recognized that major changes have taken place in the way National Meteorological and Hydrological Services (NMHSs) operate, including the rapid development of technologies that affect each and every link in the chain that carries weather information to the user. There was thus an increasing need to strengthen the interaction with various user groups for improved service delivery; the increasing demand for more tailored services and products; and the growing emergence of service providers other than NMHSs.

6.8 Effective service delivery was considered to be emerging as a key component in the recognition of credibility of NMHSs, as advocated in the WMO Strategy for Service Delivery. This means that requirements in terms of systems and infrastructure to support service delivery would need to be identified; and that the Competency Framework for PWS Forecasters and Advisors approved by Cg-17 and a new section covering general requirements for provision of public weather services, should be included in the Guide to PWS Practices.

THE IMPACTS OF WEATHER DURING 2017

(Agenda Item 7)

7.1 During 2017, most of CMO Members States were battered and bruised by tropical cyclones. The first tropical cyclone to impact a Member States was **Tropical Storm Bret**, whose centre made landfall on the island of **Trinidad** at about midnight on 20 June. Bret produced widespread **flooding** in **Trinidad** and to a lesser extent in **Tobago** and **Grenada**. The rainfall also caused **landslides** in all three islands.

7.2 The second system to threaten the Windward Islands was **Tropical Storm Don**, which passed to the south of Grenada without any major effects. **Tropical Storm Franklin** passed to the north of Belize over the Yucatan peninsula without troubling Belize. The centre of **Tropical Storm Harvey** passed just to the south of **Barbados** on 18 August. Barbados received **torrential rainfall** with possible tornadic activity and this caused **roof damage**. Flooding ensued from the rainfall in some areas on the west coast, which caused a home to leave its foundation. **Harvey** also caused flooding in **St. Vincent** which impacted on nine (9) houses and a further four (4) homes were damaged, there were also impassable roads due to fallen trees and landslides.

7.3 **Hurricane Irma,** a prolonged *category 5* hurricane devastated **Barbuda, Anguilla, the British Virgin Islands** and the **Turks and Caicos Islands**. The centre of Irma passed directly over Barbuda on 6th September, destroying more than 95% of the buildings on the island. It was reported that there were **three deaths** on **Barbuda** associated with Irma and it would cost approximately **US$200 million for reconstruction**. The centre of **Irma** then passed over **Anguilla** later that morning, with most of the damage being caused on the southern and western side of the island. While the centre of Irma was approaching Anguilla, it was also affecting **St. Kitts and Nevis,** producing rainfall and strong winds, damaged the roofs of many homes, downed power lines and felled trees. The damage caused by Irma on St. Kitts and Nevis was estimated at **XCD53 million (US$19.6 million)**. More than **80% on the houses** in Anguilla were damaged; there was one death and approximately **US$298 million in damage**.

7.4 Later that afternoon, the centre of Irma passed over the British Virgin Islands (BVI). It was reported to the Meeting that the **Department of Disaster Management** in the BVI recorded **winds speeds of 234 mph**. The wind and water caused **65% of the hotel stock** to be completely damaged and 25% partly damaged. There were **125 injuries** and **6 deaths;** the estimated cost of the **damage thus far was US$3.6 billion**. After leaving the British Virgin Islands, Irma next impacted the Turks and Caicos Islands on 8-9 September. Although the closest point of the centre of Irma to the Turks and Caicos Islands was 30 miles from Providenciales, **65% of the building stock was damaged**, hundreds of persons were displaced, but there was **no loss of life**. Grand Turk, Salt Cay and South Caicos suffered extensive damage and a State of Emergency was declared for those islands.

7.5 Hurricane Maria followed Irma approximately two weeks later. **Hurricane Maria** impacted as a *category 5* hurricane on **Dominica** on 18th September. Preliminary reports were that Maria caused at least **twenty-seven (27) deaths** in Dominica with dozens of persons missing. There was widespread wind and water damage with the attendant landslides. In **St. Vincent,** there were overflowing rivers in the northern part of the island and one (1) house lost its roof. Maria also affected **St. Kitts and Nevis** to the north of its centre. The highest sustained winds speed measured in St. Kitts and Nevis was 55 mph with highest gust of 72 mph where Maria produced 172.2 mm of rainfall and, like Hurricane Irma, there was damage to roofs, utility poles and downed trees. Maria caused significant damage to a major coastal road from destructive wave action. Maria caused an estimated **XCD 88.5 million (US$32.8 million)** in damage in **St. Kitts and Nevis**. The centre of Maria passed within 38 miles to the east of Grand Turk and Salt Cay and produced torrential rainfall over the **Turks and Caicos Islands.** Damage at that time was difficult to ascertain given the damage which was still present from the passage of Irma.

7.6 There were other hydro-meteorological events which impacted on some countries from non-cyclonic events. A week-long rainfall event associated with an abundance of deep-layered moisture lingered across the southern Caribbean and the propagation of a tropical wave interacting with the ITCZ produced flooding and landslides in Trinidad and Grenada. The passage of a tropical wave on 17 October caused flooding in St. Vincent and landslides in the Grenadine island of Bequia.

7.7 An upper-level trough on 4-5 November and the ensuing rainfall caused damage to bridges in Fitz Hughes and Chateaubelair in St. Vincent.

7.8 Jamaica reported on losses amounting to over **US$32million** from rainfall events from a Trough and Tropical Wave in May and June that caused extensive flooding. It also reported record temperatures in August and a lightning storm that closed the island's airspace in September.

SCIENTIFIC PRESENTATION

(Agenda Item 8)

(a) CCRIF SPC: - Excess Rainfall Model 2.0

8.1 **Ms Gillian Golah, Chief Operating Officer, CCRIF SPC,** provided the Meeting with an overview of CCRIF SPC. The Meeting was informed that the Caribbean Catastrophe Risk Insurance Facility was created in 2007, out of the recognition that natural catastrophes impose a significant burden on the financial ability of States to function after a disaster due to an unavailability of liquid funds. The Facility was structured as an insurance instrument to provide coverage similar to business interruption insurance in the event of losses from tropical cyclones or earthquakes for sixteen (16) Caribbean member governments. In 2013 CCRIF began offering coverage for excess rainfall as well.

8.2 CCRIF SPC presently offers earthquake, tropical cyclone and excess rainfall policies to Caribbean governments. In April 2015, CCRIF signed a Memorandum of Understanding with COSEFIN (the Council of Ministers of Finance of Central America, Panama and the Dominican Republic) to allow Central American countries to access similar coverage.

8.3 **Dr. Paolo Bazzurro, Team Leader/CCRIF SPC Risk Management Specialist,** gave a presentation on the models used to develop its Parametric insurance products which make payments based on the intensity of an event (for example, hurricane wind speed, earthquake intensity, volume of rainfall). The amount of loss is calculated in a pre-agreed model caused by these events. Therefore, payouts can be made very quickly after a hazard event. This was different from the traditional insurance settlements that require an on-the-ground assessment of individual losses after an event before a payment could be made. The presentation provided information on the three models used for the insurance products offered.

8.4 The model for tropical cyclones and earthquakes was based on the Multi-Peril Risk Evaluation System (MPRES). This system was developed for CCRIF and was supported by Kinetic Analysis Corporation (KAC), a risk modelling company with strong roots in the Caribbean. The MPRES can handle multiple hazards and hazard assessment methodologies, can accommodate a variety of input/output formats and detailed exposure classifications, and produces accurate loss estimates with known statistical uncertainty. The trigger level was dependent on the coverage purchased by individual countries. Member governments may purchase coverage, which has specific triggers such as '1-in-15-year' hurricane or a '1-in-20-year' earthquake.

8.5 In the case of hurricanes, a payout to a country would depend on the storm's intensity, track and storm surge relative to the distribution and exposure of government assets and on the attachment and exhaustion points and coverage limit that the country has selected. Once the trigger level has been reached, the payout increases as the modelled loss increases, due to higher hazard intensity, a closer track and/or greater storm surge for the storm (relative to the distribution and exposure of assets). Payouts for hurricanes are determined based on government losses calculated using storm data from the United States National Hurricane Center and parameters fixed within the loss estimation model used to underpin CCRIF's policies. The model calculates the level of wind and ocean hazards, such as storm surge, encountered across the affected area and uses the pre-fixed value and distribution of government exposures to those hazards to calculate a government loss.

8.6 The CCRIF Excess Rainfall (XSR) Model 2.0 is aimed at simulating, in real time, the precipitation over a country and rapidly estimating the potential consequent losses such that shortly after the end of the XSR event the country can receive a payout consistent with the CCRIF insurance policy conditions if that country's rainfall policy is triggered. The hazard module provides on a daily basis the estimates of the precipitation over a large domain that includes the Caribbean and Central America regions. The daily estimates are derived in near real time through a combination of climatic-meteorological models (the NCEP model and WRF model developed by the United States National and Oceanic and Atmospheric Administration - NOAA), which compute the amount of rainfall based on climate conditions, and of a low-orbiter satellite-based precipitation model.

8.7 The insurance module uses the model loss estimates to compute the payout to each country affected by an XSR loss event. The payout depends on the values of a set of parameters specified in the XSR insurance policy of each insured country. The Attachment Point represents the loss that a country decides to retain before any insurance payout begins and is similar to a "deductible" in a standard insurance policy. The Exhaustion Point is the loss value at which the full insurance payout is due.

(b) Severe Weather Forecast Demonstration Project (SWFDP)

8.8 **Mr Tyrone Sutherland** Coordinating Director of CMO, gave a presentation on the Severe Weather Forecast Demonstration Project, which would focus on severe weather which was not associated with tropical cyclones in the Eastern Caribbean, from Trinidad in the south to Puerto Rico in the north, with special arrangements for Haiti.

8.9 The aim of the Project was to improve the collaboration among Meteorological Services in the forecasting of severe weather events, including the dissemination of information to disaster management offices and other stakeholders. The presentation provided information of the meetings which had occurred to date. The Project would be centered on a Regional Forecast Support Facility, which would be housed at the Météo-France offices in Martinique. Météo-France would provide forecast guidance cascading down for the global models to regional models to national circumstances.

8.10 At the meeting of the Committee in Miami in May 2017, it was decided that an implementation plan would be developed, including an extranet site in Martinique to house the model products, development or identification of a communication mechanism, such as SKYPE or other electronic meeting software. The development of the extranet was targeted to be completed by the end of the first quarter of 2018.

OTHER MATTERS
(Agenda Item 9)

9.1 There were no matters discussed under this agenda item.

Annex I

AGENDA

1. INTRODUCTION AND ADOPTION OF AGENDA
2. STATUS OF ACTIONS FROM THE PREVIOUS MEETING
3. TRAINING
4. OPERATIONAL MATTERS
   - (a) WMO Annual Global Monitoring
   - (b) Impact Based Forecast and Warning Services
   - (c) Quality Management System
5. WIGOS IMPLEMENTATION
6. OUTCOME/HIGHLIGHTS OF THE SIXTY-NINTH MEETING OF WMO EXECUTIVE COUNCIL AND THE SEVENTEENTH MEETING OF RA IV
   - (a) WIS Implementation - BUFR Migration
   - (b) Meteorological Services for Aviation
   - (c) Public Weather Services
7. THE IMPACTS OF WEATHER DURING 2017
8. SCIENTIFIC PRESENTATION
   - (a) CCRIF SPC: - Excess Rainfall Model 2.0
   - (b) SWFDP
9. OTHER MATTERS

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ANNUAL MEETING OF DIRECTORS OF METEOROLOGICAL SERVICES

ANTIGUA AND BARBUDA
5TH NOVEMBER 2017

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National WIGOS Implementation Plans

Members should be "WIGOS Ready" Per the Plan for the WIGOS pre-operational phase this includes:

(a) OSCAR/Surface: completed WIGOS metadata of all observing stations across all WIGOS components for which observations are exchanged internationally;
(b) WIGOS metadata: compliance achieved;
(c) WIGOS Station Identifiers: implemented;
(d) WIGOS Data Quality Monitoring System (WDQMS): national process for acting on quality problem information received from the WDQMS in place;
(e) Embracing all NMHS-operated observing systems and willing partners;
(f) National WIGOS governance, coordination and implementation mechanisms established;
(g) Nomination of national WIGOS focal points and OSCAR focal points completed.

1. Further expected outcomes above the minimum level can be as follows:

(a) Enhanced national integrated observing system delivering better and better documented observational input to support national service needs in a more cost-effective way;
(b) Increased integration and open sharing of observations from WMO and non-WMO sources across national and regional boundaries;
(c) Progressively improved availability and quality of WIGOS observational data and metadata;
(d) Increased visibility and strengthened role of NMHSs at their national level;
(e) Enhanced cooperation with partners at the national and regional levels;
(f) Enhanced culture of compliance with the *Technical Regulations* (WMO-No. 49), Volume I, Part I – WIGOS and *Manual on the WMO Integrated Global Observing System* (WMO-No. 1160);
(g) Improved human and technical capacity of Members for planning, implementation and operations of WIGOS.

2. To achieve at least the minimum expected outcomes, the following key activities should take place at a national level:

(a) Analysis of current and future national strategic requirements, needs and priorities, and biggest gaps in observations, systems, processes, capabilities, etc.;

(b) Analysis of the national implications of the WIGOS concept of integration, partnerships, data sharing, WIGOS relevant technical regulations and culture of compliance, etc. at a national level;

(c) Development of a National WIGOS Implementation Plan;

(d) Critical analysis of capabilities and gaps (systems, processes, people, networks, governance, issues of compliance);

(e) Specification of expected deliverables, outcomes, milestones, and key performance indicators for the national WIGOS implementation;

(f) Establishment of governance and key relationships.

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