Technical Cooperation Workshop for Development of the Caribbean Regional Cooperation Programme in Multi-Hazard Early Warning System

FINAL REPORT

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http://www.wmo.int/pages/prog/drr/events/Barbados/index_en.html

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1. Background

1. In the Caribbean region, between 1980 and 2007, nearly 98% of disasters, 99% of casualties and 99% of economic losses related to natural hazards were caused by recurrent hydro- metrological- and climate-related events such as tropical cyclones and storm surges, floods, droughts, and extreme temperature (EM-DAT, see reference section).

2. During the Multi-Hazard Early Warning Systems (MHEWS) workshop March 2010, San Jose, Costa Rica)[1] organised under the umbrella of the World Meteorological Organization (WMO) Regional Association (RA) IV together with a number of other partners, it was recommended to develop an initiative to strengthen the Caribbean MHEWS capacities, building on the existing institutional mechanisms, capacities, activities and projects in the region.

1.1. Roadmap for the strengthening of Multi-Hazard Early Warning System Scope, objectives and approach for the development of a Caribbean MHEWS initiative to strengthen MHEWS in the region

3. Building on the outcomes of the MHEWS Workshop and follow up consultations, a road map for the design of a Caribbean MHEWS initiative to strengthen MHEWS in the region with national capacity development has been developed. This roadmap proposes to strengthen National MHEWS in the Caribbean with a 6-8 year vision together with phase I project, with 2-year implementation cycle, with the following objectives:

   (i) To strengthen national and regional institutional capacities and cooperation among the National Meteorological and Hydrological Services (NMHS) and Disaster Risk Management (DRM) agencies through development/strengthening of components of Early Warning Systems (EWS) with a multi-hazard approach for hydro-meteorological hazards;

   (ii) To enhance coordination among hydro-meteorological warning systems (building on the existing regional coordination for tropical cyclones) and other hazards (e.g., tsunamis).

4. The development of the MHEWS Caribbean Initiative is based on a phased approach engaging countries/territories and the regional mechanisms and agencies and other stakeholders supporting the region technically and/or financially, including:

   (i) ***2010 - early 2011***:Development of programmatic and technical aspects based on extensive consultations with the stakeholders in the countries/territories, regional agencies and institutions, and other stakeholders;

   (ii) ***2011:*** Identification of institutional partnerships, resource mobilization strategy and development of implementation, monitoring and evaluation processes founded in the regional processes in the Caribbean; and

   (iii) ***2011-2012***: Launch of the phase I projects upon confirmation of available resources and funding.

   (iv) ***2012 – Onwards:*** Implementation and systematic coordination for monitoring progress and evaluation and expansion planning.

5. Based on concrete recommendations of the participants in the Costa Rica MHEWS Workshop, the Caribbean MHEWS Initiative would be addressing the following issues:

   (i) Strengthening of disaster risk management and emergency preparedness coordination frameworks and governance as linked to hydrometeorological EWS;

[1] See the following webpage for the Multi-Hazard Early Warning system (MHEWS) workshop March 2010, San Jose, Costa Rica final report and meeting documents and presentations: http://www.wmo.int/pages/prog/drr/events/MHEWSCostaRica/index_en.html

(ii) Strengthening, regional harmonization, and interoperability of the observing networks and data sharing as linked to these EWS;

(iii) Capacity development in risk assessment and modeling for hydro-meteorological hazards to support EWS and emergency management with considerations for risks associated with climate variability and change;

(iv) Strengthening of operational forecasting capacities for hydro-meteorological and marine-related hazards and stronger coordination with the tsunami warning system;

(v) Strengthening of warning dissemination mechanisms, service delivery, operational cooperation and Quality Management Systems (QMS) engaging NMHS and DRM agencies;

(vi) Building/improving national Watch and Warning Systems (WWS), and exploring coordination in the region;

(vii) Strengthening coordination and realize opportunities for interoperability of crosscutting activities across national and regional agencies, particularly noting the linkages of the hydrometeorological warning system with other such as tsunami;

(viii) Educational programmes in hydrometeorological hazards and warning systems targeted at the public and officials.

6. The design of this initiative will consider countries and territories (islands) of the Caribbean with expressed interest: Antigua and Barbuda, the Bahamas, Barbados, Belize, Bermudas, the British Caribbean Territories, Cuba, Dominica, the Dominican Republic, the French West Indies, Grenada, Guyana, Haiti, Jamaica, the Netherland Antilles and Aruba, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

1.2. The Assessments of the Capacities, Gaps and Needs for the Development of the Caribbean Regional Programme

7. Following the outcomes of the Costa Rica MHEWS Workshop, and in preparation for the "Technical Cooperation Workshop for Development of the Caribbean Regional Cooperation Programme in Multi-Hazard Early Warning System" (hereafter called Barbados MHEWS Workshop) in Barbados (2 – 5 November 2010), the WMO carried out a review of literature and information available on the status of EWS in the Caribbean, from the perspective of both the DRM Agencies and the National Meteorological and Hydrological Services. It emerged that a number of assessments have been carried out in the region which has relevant information for the development of a regional MHEWS project. These assessments take the form of surveys, consultation reports and benchmarking tools that were provided by different international and regional organizations (Table 1).

8. Additionally, a number of EWS-related projects have already been carried out, or are currently being implemented in the Caribbean region. The list and the description of these projects are available in Tables 2 & 3. A project consultant was hired by the WMO to assess this information and to carry out in-country visits (during the period between July and September 2010) in order to collect additional data on the specific capacities, gaps and needs of the different countries and territories in the Caribbean. During country visits in Trinidad and Tobago, Barbados, Dominica, Antigua & Barbuda, Saint-Lucia, Martinique, Cuba, Dominican Republic and Bahamas (through teleconference), meetings were held with Directors of the DRM Agencies, Directors of the Meteorological Services and representatives of hydrological institutions or water resource authorities. Regional bodies (Caribbean Meteorological Organization (CMO), Caribbean Institute for Meteorology and Hydrology (CIMH), Association of Caribbean States (ACS), Caribbean Disaster Emergency Management Agency (CDEMA), Caribbean Hydrological Cycle Observing System project (Carib-HYCOS) were also visited in an effort to improve the understanding of the capacities, gaps, needs and challenges at the regional level. The consultant was then charged with the

task of compiling the available information into a working paper. This document, called "Preliminary Draft Report of the Assessments of the Capacities, Gaps and Needs for the Development of the Caribbean Regional Programme on Multi-Hazard Early Warning Systems and Phase-I Project Priorities: Focus on Hydrometeorological hazards warning systems and possible linkages with other warning systems" (also referred to as Doc 4) was presented to participants in advance of the Barbados meeting.

9. Two of the main findings of this assessment are related to the various categories of countries/territories with regard to their Meteorological Services (NMS), and the various types of relationships between Meteorological Services and DRM Agencies in the Caribbean region. These can be characterized as follows:

10. There are three categories of countries/territories with regard to Meteorological Services (NMS) (left column in Figure 2) including:

NMS I: Countries/territories with Meteorological Service with full capacities to support DRM Agencies

NMS II: Countries/territories with national or local Meteorological Service, with limited capacities, (e.g. no forecast and warning office) that need support from another island to fulfill their mandate to support the DRM Agency of their country

NMS III: Countries/territories without Meteorological Service

11. In this context, two types of relationships between the DRM Agency and the Meteorological Service have been identified, including:

Relationship I: National or local DRM Agency receives support from the meteorological service from the same country/territory (Figure 3 & 4)

Relationship II: National or local DRM Agency receives support from the meteorological service located in another country/territory (Figure 5)

12. .Additionally, Doc 4 documents the capacities, gaps and needs of the Caribbean countries and territories regarding (i) Policy, legal, legislative issues pertaining to Disaster Risk Reduction (DRR) and role of NMHS, (ii) Risk Assessment and Modelling, including data management and exchange issues, (iii) Operational Cooperation of National Meteorological and Hydrological Services and Disaster Risk Management Stakeholders (iv) Monitoring, Forecasting capacities, and (iv) Watch and Warning Systems. Doc. 4 was used as a basis for discussions during the entire Barbados MHEWS Workshop.

1.3. Hurricane Tomas

13. Just prior to the beginning of the Barbados MHEWS Workshop, Hurricane Tomas moved through the Windward Islands into the Caribbean, affecting Barbados, Saint Lucia, Saint Vincent, and later also Curaçao and Haiti. The storm caused an estimated 41 casualties and over US$572 million in monetary losses, mainly on Saint Lucia, before dissipating on 7 November. Despite the storm's impact on the Lesser Antilles and the threat to other islands further west, representatives from DRM Agencies and Meteorological and Hydrological Services were able to travel to Barbados and attend the Barbados MHEWS Workshop. This alone illustrates the heartfelt dedication of participants to the topic of the Barbados MHEWS Workshop and the implementation of a regional initiative to strengthen MHEWS in the Caribbean.

14. During the Barbados MHEWS Workshop, an overview of the impacts of hurricane Tomas in St. Lucia and St. Vincent was presented. The storm produced strong winds and record rainfall that led to multiple landslides, especially in the Southern part of St. Lucia. The rapporteur from St. Lucia stressed the challenges that were encountered during disaster response, namely a lack of anticipation, difficulties in communicating and in assessing the damage, as well as the fact that the island had effectively been cut into two parts due to destruction of the two main bridges. Participants from Curaçao also reported on damage

caused by the unanticipated record rainfall and subsequent flooding associated with Tomas in the days preceding the Barbados MHEWS Workshop.

1.4. Political change in the Dutch West Indies

15. On 10 October 2010, the Netherlands Antilles were officially disbanded. The islands of Curaçao and Sint-Maarten gained more autonomy and became constituent states within the Kingdom of the Netherlands, effectively giving them the same political status as Aruba. Bonaire, Saba and Sint Eustatius became a special municipality of the Netherlands itself and will therefore be required to apply Dutch law. It is expected that these changes will have at least some impact on the organization of the Hydrometeorological Service and DRM Agency. Uncertainties remain as to regional support mechanisms (e.g. through membership of regional entities) with regard to Meteorology, Hydrology and Risk Management.

2. About the Barbados MHEWS Workshop

2.1. Objectives

16. The objectives of the Barbados MHEWS Workshop were to:

    (i) Develop priorities for the Caribbean MHEWS regional programme;
    (ii) Prioritize activities and recommendations for institutional arrangements for strengthening the capacities in MHEWS; and
    (iii) Present and further refine needs and gaps in MHEWS in the Caribbean region as well as regional capacities and gaps.

2.2. Participants

17. The participants of the Barbados MHEWS Workshop included National and Technical experts from the Meteorological and Hydrological Services as well as the DRM Agencies from 27 countries/territories of the Caribbean region and from other countries of good practices and representatives from development agencies and bi-lateral donors (Annex I: List of Participants).

2.3. Format of the Sessions

18. The Barbados MHEWS Workshop was comprised of both six sessions and three working groups (see Annex II for the Agenda of the meeting). The sessions sought to thematically present available capacities as well as discussions of needs and gaps in the region.

19. For Sessions 3, 4 and 5 the participants were divided into three Working Groups (Annex III) based on the specific type of relationship that exists between NMHS and DRM to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts and identify concrete recommendations and priorities for strengthening thematic areas that will be addressed in the Caribbean MHEWS Initiative.

20. Prior to the Barbados MHEWS Workshop a “Questionnaire for the Working Groups” was disseminated among the participants in advance (Annex IV). The survey asked questions relevant to the thematic topics for the Working Groups in Sessions 3, 4 and 5 of the Barbados MHEWS Workshop. Annex I of the Questionnaire contained questions to update the Register of Alerting Authorities, maintained by WMO to publicize the sources of alerts regarded by WMO Members as authoritative. In total, nine of the 26 countries responded to the survey (Table 4), and Table 5 summarizes the respondent’s priorities in five areas including NMHS and DRM Operational Cooperation & Service Delivery, Risk Analysis and data management, Forecasting Capacities, Monitoring and Coordination of Watch and Warnings.

21. The main issues discussed in each session are summarized below:

Session 1: Opening and Introduction

22. The Barbados MHEWS Workshop was opened by Mr. Hampden Lovell, Director of the Meteorological Services of Barbados and Permanent Representative of Barbados with the WMO, with a welcome statement delivered by Dr. Maryam Golnaraghi, WMO, on behalf of the WMO Secretary General, by Mr. Jeremy Collymore, Director of CDEMA and by Mr. Hansen, on behalf of the United Nations (UN) Resident Coordinator in Barbados. The background and objectives of the Barbados MHEWS Workshop were presented as well as the basic principles of DRM, particularly with respect to MHEWS. Additionally, the Workshop was given an overview of the scope, outcomes and recommendations from the Training and Coordination Workshop on MHEWS held in Costa Rica in March 2010.

Session 2: Review of the assessment of the institutional capacities, gaps and needs in MHEWS in the Caribbean

23. In this Session, the Barbados MHEWS Workshop was presented with Doc 4 assessments and outcomes as well as the preliminary results of the telecommunications survey conducted by United States National Oceanic and Atmospheric Administration - National Weather Service (NOAA-NWS) in the Caribbean region. In Panel I, technical experts from CDEMA, WMO RA IV, CMO, United Nations Development Programme (UNDP) and non-CMO/CDEMA members presented their views on the strategic priorities of the Caribbean region in DRR and Meteorology/Hydrology/Climate and Tsunami EWS-related issues, as well as regional reflections on the outcomes of past projects, assessments and consultations.

Session 3: Operational Cooperation of the NMHS and DRM Agencies and Service Delivery for MHEWS (National and regional perspectives)

24. Session 3 consisted of presentations/discussions on good practices using QMS and Standard Operating Procedures (SOP), engaging the NMHS and DRM stakeholders for meeting user needs. Participating in the panel were representatives from different WMO departments, the Finnish Meteorological Service, the DRM Agency of Finland, Météo-France, the French Civil Security department, NOAA-NWS and the Cooperative Program for Operational Meteorology, Education and Training (COMET). Issues that were discussed include processes for identification of EWS stakeholders and their needs, forecast and warning product and service development, communication and dissemination of warnings, Common Alert Protocols (CAP), and feedback mechanisms for continual improvements of EWS. The Working Groups convened to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts, as well as identification of priorities for strengthening of these areas. The session concluded with a plenary discussion in which the working groups presented concrete recommendations for high priority activities.

Session 4: Risk Analysis, Data Management and Exchange Issues to support DRM and EWS with Multi-Hazard Approach (National and regional perspectives)

25. Session 4, consisted of presentations and discussions on the topics of risk analysis and data management and exchange issues. Experts representing the WMO, the World Bank, CIMH, Caribbean Catastrophe Risk Insurance Facility (CCRIF), the Carib-HYCOS programme and RA IV WMO Integrated Global Observing System (WIGOS) presented experiences and examples in hazard analysis and risk assessment/modelling from the region, while also exploring the challenges and needs for strengthening existing capacities with regard to data availability, quality and exchange, hazard and risk modelling tools and the overarching need for cooperation and training. The Working Groups reconvened to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts, as well as identification of priorities for strengthening of these areas. The session concluded with a plenary discussion in which the working groups presented concrete recommendations for high priority activities.

Session 5: Monitoring, Forecasting and Watch and Warning Systems (National and regional perspectives)

26. In Session 5, participants discussed the coordination of real-time observation networks and monitoring as critical input for forecasting systems, as well as the coordination and strengthening of forecasting capacities. The session furthermore addressed challenges and opportunities for coordination of watch and warning systems in the region. Following a panel discussion with experts from WMO, CIMH, the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS) and the United Nations Educational, Scientific and Cultural Organization Intergovernmental Oceanographic Commission (UNESCO-IOC), NOAA-NWS, the RA IV Hurricane Committee and CMO, the Working Groups reconvened to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts and to identify priorities for strengthening these areas through a Caribbean MHEWS regional programme.

Session 6: Final Synthesis and Recommendations

27. In the final session, participants reviewed the overall outcomes of the Barbados MHEWS Workshop and discussed the concrete recommendations for the development of the Caribbean Regional MHEWS Programme, particularly focusing on the priorities for Phase-I project development. Different international and regional funding and development agencies (namely UN Agencies, the Finnish Development Agency and the Inter-American Development Bank (IADB) then reflected on the different areas they support in the MHEWS Programme. The session was concluded with a summary of the outcomes of the workshop and concrete steps for the way forward, and closing remarks by the UN Resident Coordinator and the Permanent Representative with the WMO of Barbados.

3. Synthesis of Discussions, Conclusions, and Recommendations from the Sessions

3.1. Session 2: Synthesis of Strategic priorities of the Caribbean region in DRR and Meteorology/Hydrology/Climate and Tsunami early warning systems related issues and regional reflections on the outcomes of the assessments and consultations

28. The Barbados MHEWS Workshop was presented with the findings documented in Doc. 4 on the common gaps, needs and priorities identified in the analysis of the assessments projects and consultations with the participating countries/territories and regional agencies. Doc 4 documents the national policies, legal frameworks and institutional arrangements, and provided an assessment of capacities and needs for strengthening operational cooperation on MHEWS, covering a comprehensive set of core capacities and functions of Meteorological and Hydrological Services.

29. A summary of the preliminary results of a region-wide survey on telecommunications in WMO RA III (South America) and RA IV (Central America, North American and the Caribbean) was presented to the Barbados MHEWS Workshop. Amongst others, the results show that almost all respondents experience connectivity, power outages, and maintenance as recurring problems. While 90% of respondents indicate the use of landline internet for routine operations, they also agree on a need for more bandwidth for communication. 80% host their websites externally, and only 3 countries reported having an operational radar in place.

30. In the Panel and the following plenary discussions, participants reflected on the findings of these assessments and studies, on the lessons learned from the recent impacts of Hurricane Tomas in the region, and highlighted the following strategic priorities for the strengthening of MHEWS in the Caribbean region:

(i) Regional and country / territory ownership: The need for regional ownership in this initiative was stressed as well as the importance of identifying the specific roles and responsibilities of each stakeholder.

(ii) Building on the existing initiatives and projects: As mentioned earlier, a number of EWS-related projects (listed in Tables 2 & 3) have already been carried out, or are currently being implemented in the Caribbean region. It was stressed that the present MHEWS Caribbean Initiative should leverage these capacities and projects to prevent duplication of effort as well as to ensure cost and resource efficiency. In this regard, CMO projects and activities to strengthen observation capabilities and UNDP projects (The Caribbean Risk Management Initiative (CRMI) and the Regional Risk Reduction Initiative (R3I)) outcomes and potential linkages with the Initiative were highlighted.

(iii) Inclusion of all stakeholders: It was stressed that inclusion of all EWS stakeholders from various sectors is necessary for the development of national MHEWS as well as regional support mechanisms.

(iv) Prioritization of capacity development: The participants highlighted that capacity development through this initiative should be prioritized according to maximum benefit of the beneficiaries of MHEWS.

(v) Ensuring sustainability of capacity development: The participants highlighted that due consideration should be given to sustainability of the capacity developed through this initiative. In this regard, leveraging of current capacities, initiatives and projects, long-term planning as well as financial sustainability should be considered.

(vi) Legal implications at national level: It was highlighted that the implications of a regional strategy for the Caribbean MHEWS Initiative on national legislation need to be addressed in parallel to implementation.

(vii) Lessons learned from Hurricane Tomas: The importance of lessons that could be learned from the passage of tropical cyclone Tomas (November 2010) was highlighted. These include the need to strengthen the relationship between DRM Agencies and Meteorological and Hydrological Services; to better understand capacities and challenges; and to ensure better communication to the public. Tomas also highlighted the need for critical products and services (e.g. regular monitoring through aircraft recognisance and guidance products) provided by the Regional Specialized Meteorological Center Miami Hurricane Center (RSMC-Miami) to NMS and DRM Agencies in the Caribbean.

3.2. Session 3: Operational Cooperation of the NMHS and DRM Agencies and Service Delivery for MHEWS (National and regional perspectives)

31. The WMO Secretariat presented the assessment findings documented in Doc 4 on service delivery and operational cooperation between NMHSs and DRM Agencies. The different relationships between Disaster Management Agencies and Meteorological Services were highlighted and the gaps and needs summarized. The participants were then presented with questions that would facilitate the Working Group's discussions, specifically pertaining to relationships between Meteorological Services, DRM Agencies and other technical institutions in MHEWS context; QMS and SOP; Evaluation and Feedback; Service Delivery; Dissemination Mechanisms; and Regional Cooperation.

32. During the Panel, Working Groups session (see Table 6) and discussions, participants reflected on the findings of the assessment and on the presentations of the panellists. The following outcomes and recommendations emerged:

(i) Operational cooperation and collaboration of Meteorological Service and DRM Agencies: It was highlighted in the meeting that improvement is needed in the relationship between Meteorological Service and the DRM agencies. Specifically,

a. *For Countries / Territories with a Type I and II relationship between NMS and DRM* (see 11): Improvement is needed with regard to (i) understanding of each others roles and responsibilities in the EWS (ii) development/improvement of legislation, QMS and/or SOP that govern the relationship between the Meteorological Services and the DRM Agency (iii) real-time coordination of watches and warnings during disaster events, (iv) DRM agency feedback for meteorological service product development. Furthermore, the meeting discussed specifically:

b. *For Countries / Territories with a Type II relationship*: In addition to the improvements mentioned in a., it was highlighted that special attention should be given to relationship type II countries where a meteorological service has the mandate to support a DRM Agency in another island/territory which has no meteorological service. In this case, the separation between the meteorological service and the DRM Agency, especially when the distances are large, can lead to confusion during hazard events. There is then a crucial need to document the procedures through clear Memoranda of Understanding (MoU) and SOP.

(ii) QMS: The need for, and use of, QMS in Weather Services was highlighted as a method for meteorological services to improve their operational mechanisms and linkages to EWS stakeholders (see Figure 6 for details and a schematic of the operational linkages of Meteorological Services with EWS stakeholders). QMS is governed by the International Organization for Standardization (ISO) 9001:2008 standard which has seven principals including; (i) managers are committed to use the quality management principals (ii) Quality policy, quality objectives and customer requirements are defined (iii) Processes are planned to produce the services needed, (iv) process for control of nonconformities is in place (v) Principle of continuous improvement is practiced (vi) internal audits and management reviews are in use (vii) control of documents is working. The meeting noted that efforts in the region are already underway for QMS certification of aeronautical meteorological services and that International Civil Aviation Organization (ICAO) has mandated implementation of QMS for all aeronautical meteorological services by November of 2012. In this regard, it was highlighted that QMS certification should be broadened to not just aviation services but also meteorological services in general as well as the linkages between the meteorological services and EWS stakeholders. In this regard two good practices, the French West Indies (FWI) and the United States were highlighted: (i) the FWI QMS which consists of established SOP for all aspects of crises management from meteorological forecasting, risk assessment, planning, dissemination and communication, and feedback, and the (ii) The United States Weather Service comprehensive approach to DRM governed by QMS and SOP.

(iii) Service delivery: In the discussions and working groups, strengthening service delivery was highlighted. It was highlighted that NMS should work to engage with their stakeholders to identify their needs and requirements for product development well as the frequency of delivery. In this respect, specialized training should be considered for (i) disaster managers on interpretation and use of hydrometeorological tools and products, (ii) meteorologists on disaster management processes and requirements, and (iii) media training for meteorologists to provide scientific information to the public. It was also highlighted that Guidelines and resources for service delivery are available through WMO technical programmes. Other areas discussed for strengthening service delivery included training on meteorological and hydrological product development, targeting specific vulnerable groups (e.g. elderly, children, tourists, different languages), leveraging new forms of communication such as Short Message Service (SMS) and social networks.

(iv) Dissemination systems: It was highlighted that in many of the countries/territories, communication and dissemination systems are not sufficient or unreliable during severe hazard events and therefore need to be upgraded along with backup and fall-over systems to ensure continuity of service.

(v) CAP: The meeting was informed that the CAP alert can be utilized for any hazard, can be carried over any electronic medium and targeted to specific groups, individuals and affected areas. CAP has a range of five values for each of the three aspects that it uses namely urgency, severity and certainty. A CAP register has been developed that can, amongst others, be used by WMO members to identify their officially recognized alerting authorities. It was specifically stressed that CAP is a truly multi-hazard dissemination protocol and can be used for warnings, bulletins and even normal forecasts and which addresses all-media and all-hazards through common standard. It was also specifically highlighted that:

a. *Warning Issuance*: there is a need to clarify the roles and responsibilities for warning issuance at national level (through standardized protocols such as CAP) and to ensure the authority and authenticity of information through better communication and harmonized terminology

b. *CAP system implementation*: CAP system was currently being implemented in Anguilla and that it should be implemented region wide as it simplifies and standardizes watch warning information as well as would contribute to the harmonization of warning systems in the Caribbean region

(vi) Education and Training: An example from the field of education and public outreach through the COMET Programme was presented to the participants. COMET provides many education and training modules related to MHEWS via the International MHEWS site on MetEd[2]. The modules are specifically designed for NMHS and Emergency Management professionals, as well as for policy makers and the general public. It was recognized that this on-line training approach was particularly useful for capacity development in the Caribbean and should be downscaled to the needs and requirements of the countries/territories of the Caribbean.

33. In addition, specific issues related to Type I and II relationships on Operational Cooperation of the NMHS and DRM Agencies and Service Delivery for MHEWS that emerged from the discussions are highlighted in Table 9.

Recommendations

34. The Workshop recommended that the expected outcomes of the Caribbean MHEWS Initiative should include

(i) Reviewed and updated policies, legislation and legal frameworks in support of DRR and EWS, based on good practices (e.g. CDEMA legislation models and tools)

(ii) Developed and implemented comprehensive QMS in the Meteorological Services and specific SOP across agencies and within other technical institutions, centered on EWS-user needs and operational cooperation. In this regard territories/countries where the NMS supports another NMS or supports another countries DRM Agency will have specific QMS/SOP for each relationship; This would include:

- Developed risk-based, multi-agency mechanism to identify the needs and requirements for meteorological, hydrological and climate products and services, such as (i) Data Products, (ii) Hazard analysis (statistical and forward looking), (iii) Forecast and warnings, and (iv) Technical Advise and operational support
- Mapping and documenting of multi-sectoral institutional coordination and relationships through established QMS and SOP

[2] http://www.meted.ucar.edu/hazwarnsys/haz_drr.php

- Strengthened dissemination mechanisms among EWS stakeholders, including DRM Agencies and Meteorological and Hydrological Services through (i) Strengthening of regionally harmonized protocols (e.g. CAP) (ii) integrated tools or systems with automated processes, (iii) strengthening of back up systems (including agreements for back up between different countries/territories) and (iv) improvement of the capacities of the Meteorological services for a comprehensive management of their public web sites.
- Enhanced feedback mechanisms in QMS, SOP, exercises and post event evaluations

(iii) Enhanced credibility and impact of live communication on Media through (i) bilateral workshops and training with forecasters and Media specialists and/or journalists; (ii) specific integrated tools or systems dedicated for TV broadcast, and (iii) targeting specific populations (e.g. tourists, youth)

(iv) Developed multimedia educational programmes and materials on all Hydro-Meteorological and climate related hazards and risks with specific attention to vulnerable groups in society and to local needs, by making use of local examples; through partnership/cooperation with DRM Agencies and other national and international organizations

3.3. Session 4: Risk Analysis, Data Management and Exchange Issues to support DRM and EWS with Multi-Hazard Approach (National and regional perspectives)

35. The WMO Secretariat presented the findings from its assessment on risk assessment. The participants were then presented with questions to be answered through the different working groups, pertaining to risk assessment issues.

36. During the Panel, the Working Groups session (see Table 7) and the following discussions, participants reflected on the findings of the assessment and on the presentations of the panellists. The following outcomes and recommendations emerged:

(i) Legal framework and institutional arrangements: It was highlighted that legal framework and institutional arrangements for the development of risk assessment is fundamental to an effective MHEWS. It was proposed to organise National and Regional Policy Dialogues on DRR and EWS that would facilitate the review of the legal framework and institutional arrangements in each country/territory. In the case of country/territory with Type II relationship, the country/territory without NMS needs to carefully define the roles and responsibilities for the provision of hazard data and analysis, with proper institutional arrangements (MoU, SOP) between the two countries /territories.

(ii) Mapping of stakeholders in risk assessment: As assessing risks requires to integrate a variety of data from hazards data to exposure and vulnerability information (including socio-economic data), the discussions highlighted the need for mapping all stakeholders involved in risk assessment and MHEWS data management at the national and regional levels, and the identification of institutions responsible for the hydrometeorological data at the national level and regional levels. This would allow development of an inventory of meteorological, hydrological and hazard data available at national and regional level, including for metadata and accessibility (e.g. database, disks, paper).

(iii) Hydrometeorological data collection: The meeting was informed of Carib-HYCOS, a regional hydrological observation project aiming to modernize existing hydro-meteorological networks in the Caribbean; and to improve the knowledge of regional hydro-meteorological phenomena. The need to improve the hydro-meteorological data coverage in time and space, especially in countries/territories without Meteorological service (Type III) was mentioned. It was highlighted that the development of a regional programme for the acquisition of high resolution

topography and bathymetry data would be particularly helpful to support hazard modelling. Participants discussed the potential for QMS to address issues of quality of observations, especially pertaining to the calibration of instruments in the region where capacities and resources as to calibration laboratories are rare (there is only one regional laboratory, namely in CIMH). The need to strengthen data rescue and quality control capacities (human resources, methodologies, tools, etc.) was also discussed.

(iv) Data management and sharing: It was noted that the sharing of data forms the cornerstone of risk reduction programmes. Data management should be implemented by building on already existing practices, and by using Established Open Standards, of which CAP and WIGOS were indicated as good examples. The establishment of policies and frameworks for these protocols can facilitate data exchange and compatibility. Since different systems – which are generally not up to date - are used throughout the region for meteorological data archiving and climatology (e.g. clicom, clidata, climsoft), participants expressed a need to upgrade and harmonize the software for data archiving and management. As to data sharing policy, it was noted that these exist for countries that signed up for the CARIB-HYCOS project, or that are under CMO regulations and high level agreements. In addition, non-CMO members could benefit from the extension of the scope of CIMH for data exchange.

(v) Risk analysis and modelling: Risk analysis and modelling was presented as a critical tools for a variety of purposes such as (i) Visualization of hazard and risk, (ii) Infrastructure design, (iii) Climate change adaptation, (iv) Analysis of financial exposure, (v) Cost Benefit analysis for mitigation and prevention investments, (vi) Territorial planning, (vii) Scenario analysis for emergency preparedness, and (viii) Immediate damage assessment. A comprehensive risk analysis is based on hazard and vulnerability analysis, which require specific tools and methodologies. The needs for the development of a regional methodology for risk analysis and modeling (including for flooding, landslides and coastal inundations), together with capacity development of national and regional institutions or centers and the exchange of good practices (e.g. Cuba, Jamaica) were highlighted. On the hazard analysis side, the various programmes of the WMO (e.g. Floods, droughts), as well as CIMH can provide support in this respect. On the vulnerability side, and the risk modelling, examples from CCRIF and the World Bank in the Caribbean and Central America regions were presented. It was also mentioned that the development of the insurance sector can be an important partner for the development of risk analysis and modeling capacities.

(vi) Climatology: It was noted that climate forecasting and trend analysis tools provide unprecedented opportunities to support sectoral risk assessment and management. The discussions highlighted that many capacities exist in the region (especially at CIMH), but that difficulties at national level continue to exist with regard to the availability and use of tools and products. Other points raised include (i) the importance of lessons learnt from climatological extremes in the past for better resource management (e.g.: water, agriculture); (ii) the need for renewal of data rescue management programmes and workshops; and (iii) the importance of reviving the Regional Climate Forum for seasonal forecasts and beyond.

37. In addition, specific issues related to Type I and II relationships on Risk Analysis, Data Management and Exchange Issues that emerged from the discussions are highlighted in Table 9.

Recommendations

38. The Workshop recommended that the expected outcomes of the Caribbean MHEWS Initiative should include

(i) Institutional mapping of stakeholders (national and regional) involved in all aspects of risk assessment including their roles and responsibilities and capacities

(ii) National multi-stakeholder mechanisms developed to support risk assessment

(iii) Developed/strengthened capacities for integrated, quality controlled and sustainable Global Information System (GIS) databases with meta-data and climatological (data rescue) and exchange mechanisms at national and regional levels

(iv) Accesses to high resolution topography and bathymetry

(v) Developed/strengthened hazard analysis, mapping and product development capacities through integrated modeling

(vi) Established Regional Climate Outlook Forum

3.4. Session 5: Monitoring, Forecasting and Watch and Warning Systems (National and regional perspectives)

39. In line with the prior sessions, the WMO opened the session with a presentation of the findings from its assessment on monitoring, forecasting and watch and warning systems, followed by suggestions for questions to be answered through the different working groups. These questions pertained to data, information and models for forecasting; forecasting capacities; coordination among technical agencies for forecasting activities; products from regional centres; telecommunication networks; meteorological observation networks; other observation networks and cooperation; the mandate and stakeholders for watch and warning systems; coordination mechanisms; and regional cooperation.

Forecasting capacities and related telecommunication issues

40. During the Panel, the Working Groups session (see Table 8) and the following discussions, participants reflected on the findings of the assessment and on the presentations of the panellists. The following outcomes and recommendations emerged:

(i) Improving forecasting capacities for hydrometeorologoical hazards: It was highlighted that there is a need to improve forecasting capacities of severe weather, flash floods, storm surges and other marine and coastal related hazards such as coastal inundation.

(ii) Strengthening forecasting capacities based on existing regional cooperation on tropical cyclones : The existing regional cooperation for the forecasting of tropical cyclones, with the WMO RA IV Hurricane Committee and the RSMC-Miami Hurricane Center, has demonstrated the value of cooperation in forecasting in the region. In this respect, the leveraging of these existing cooperation mechanisms should be explored for other hazards. It was shown that the contribution of the Hurricane Committee to the Tropical Cyclone Watch and Warning System in the Caribbean is regulated in two main documents, namely the body's annually-updated Hurricane Operational Plan[3], which records the agreements reached on the sharing of responsibilities for the forecast and warning services, and their infrastructures, and its Technical Plan[4]. The role and responsibilities of the RSMC-Miami in providing tropical cyclone forecasts and guidance products for the 30 Members of the WMO RA IV Hurricane Committee was also presented. An overview of the specific capacities and activities of the RSMC-Miami is available in Annex VI.

[3] The RA IV Hurrican Operational Plan can be found at:
http://www.wmo.int/pages/prog/www/tcp/documents/TCP30_2010_OpsPlan_En.pdf

[4] RA IV Hurricane Committee's Technical Plan and its Implementation Programme can be found in the Final Report of the RA IV HURRICANE COMMITTEE THIRTY-SECOND SESSION Hamilton, Bermuda (8 to 12 March 2010):
http://www.wmo.int/pages/prog/www/tcp/documents/FINALREPORT_HC-32_en.pdf

(iii) WMO operational network for forecasting capacity development: WMO, through its ten Scientific and Technical Programmes, its eight Technical Commissions, operational network of the NMHS of its Members and in partnership with a number of leading technical agencies and centers of excellence, provides a wide range of technical capacity development and training activities related to forecasting, Specifically, the Severe Weather Forecasting Demonstration Project (SWFDP) is a practical and beneficial platform for forecasting capacity development through a regional multi-hazard cooperation approach. Opportunities also exist for a synergy with the Flash Flood Guidance System (FFGS), a diagnostic tool for the assessment of the potential for flash flooding, as well as with a number of other WMO initiatives related to ocean-marine issues such as the Coastal Inundation Forecasting Demonstration Project (CIFDP) and the Storm Surge Watch Scheme.

(iv) Hydrology input in operational forecasting: It was highlighted that there needs to be additional efforts and cooperation to include hydrological information data and products in forecast and warning products. In this context, the passage of Hurricane Tomas revealed the importance of integrating hydrological data for initial conditions such as saturation of soil in operational forecasts and warnings.

(v) Technical Training for forecasters: Specific areas for the development of the forecaster's technical capacities were highlighted. These include: radar and satellite interpretation; utilization and communication on probabilistic forecasts; and seasonal forecast and climate services and products. In this respect, the regional role of CIMH and CMO (through its radar project) to facilitate training in these areas was highlighted. The expansion of their scope to provide these trainings to all Caribbean countries/territories was also discussed.

(vi) Development of regional capacities for forecasting: It was highlighted in the discussions that to fill gaps and needs of the countries/territories in modelling, regional capacities should be strengthened or developed. These include higher resolution models (such as mesoscale models), probabilistic outputs and regional wave models.

(vii) Climate forecasting: A need to strengthen the capacities at national level for climate forecasts (especially for drought and water management), based on regional guidance and products was discussed (e.g. from CIMH or the Caribbean Community Climate Change Center (CCCCC). Participants also discussed issues of awareness and feedback on different kind of forecast products provided by CIMH, and opportunities to extend the scope of products and beneficiaries.

Recommendations

41. The Workshop recommended that the expected outcomes of the Caribbean MHEWS Initiative should include:

(i) Strengthened and expanded forecasting capacities for all the Meteorological and Hydrological hazards (tropical cyclone and disturbances generating strong winds, heavy rainfall and damaging waves that could create flashfloods, landslides, coastal surge and inundation, drought) through:

- Upgraded forecasting system that facilitates easy and integrated access to a wider variety of numerical products (including regional atmospheric and waves models and probabilistic products)
- Implemented intelligent and integrated forecasting guidance systems for severe weather (strong wind, heavy rain, storm surge, damaging waves), flash flood (Flash Flood Guidance System) and drought at regional level
- Forecasters trained in the latest methodologies and analysis techniques, including probabilistic and deterministic model outputs and radar/satellite interpretation for the tropics.

(ii) Role of regional centers are strengthened to provide forecasting guidance tools and products downscaled to country/territory level for all meteorological, hydrological and marine hazards and to develop/strengthen coordination mechanisms for consensus building

(iii) Strengthened real-time exchange and coordination mechanisms at sub-regional level, especially in the case of neighboring forecast offices and of NMS II countries/territories

(iv) Strengthened telecommunication networks at regional and national level through:

- Improved transmission systems for dissemination, exchange and data collection at national to regional levels
- Enhanced reliable systems for back-up and redundancy, with specific agreements and SOP among different countries/territories
- Upgraded internet capacities and web management capabilities

Observation networks and related telecommunication issues

42. During the Panel, the Working Groups session (see Table 8) and the following discussions, participants reflected on the findings of the assessment and on the presentations of the panellists. The following outcomes and recommendations emerged:

(i) Coverage: The meeting highlighted that many countries / territories in the region have insufficient coverage for their meteorological and hydrological observation networks. Local orographic and coastal effects of extreme events are often not adequately monitored or even detected. Additionally, discussions on the recent case of Hurricane Tomas, concluded that more anticipatory action is needed and also focused on the need for the extension to the east of hurricane reconnaissance flights.

(ii) QMS, standardisation and interoperability of equipment: It was highlighted that there is a gap in the standardisation and interoperability of observation equipment and their output both at the national and regional levels, due to the different standards applied by various projects and initiatives. In addition, the lack of consideration with regard to sustainability issues such as maintenance, has often led to the degradation of this equipment. In this respect it was discussed that there is a need for the development of QMS/SOP for observing networks to frame quality control (calibration) and maintenance, building on existing regional capacities (e.g. CIMH). It is also necessary to enhance the coordination among projects and programmes taking care of monitoring networks for better sustainability, compatibility and interoperability.

(iii) Sharing of hydrometeorological observations, real-time observations and telecommunications issues: The need for increased sharing of observations (including real-time) both among technical agencies at the national levels and across the region was discussed. Radar data sharing and the development of seamless radar mosaics, was particularly discussed during the presentation of the CMO radar network project. Finally, the strengthening of telecommunications capacities for real-time data exchange was also highlighted.

(iv) Hydrological and marine observations: A number of regional initiatives in the field of comprehensive flood forecasting were discussed in detail, including the Carib-HYCOS Project, the Caribbean Regional Weather Radar Project, and the Real-time Flood Forecasting Project, highlighted the need for integrating the various monitoring networks. With regard to coastal inundation, it was noted that this is a crosscutting issue, caused by a number of different hazard events (tsunami, storm surge, long swell). Coastal inundation would therefore be a good opportunity to leverage funding and resources for coastal marine observing network through tsunami programme and other integrated coastal marine programmes.

Recommendations

43. The Workshop recommended that the expected outcomes of the Caribbean MHEWS Initiative should include:

    (i) Strengthened observation and monitoring capacities at the national level through:

    - Improvement of time and space coverage with a special attention to NMS III islands without real-time observation networks;
    - Strengthened coordination among technical agencies that manage their own hydro-meteorological networks, for better interoperability and real-time exchange
    - Development of sustainability plans for observing networks (e.g. maintenance plan, spare parts, quality control methods, training)
    - Improvement of sharing of regional observation data that is crucial for severe weather monitoring, such as radar, wave rider or lightning data;

    (ii) Strengthened real-time coordination and collaboration across technical agencies at the national level (meteorological, hydrological, coastal, etc.) for data exchange and multi-sectoral input in forecast and warning process

    (iii) Standardized and integrated regional observations networks (based on Carib-HYCOS, Carib WIGOS, Radar project, etc.) and accessibility to every country/territory.

Coordination of multi-hazard watch and warning systems (multi-hazards, multi-stakeholders, national, regional)

44. During the Panel, the Working Groups session (see Table 8) and the following discussions, participants reflected on the findings of the assessment and on the presentations of the panellists. The following outcomes and recommendations emerged:

    (i) Multi-Hazard Watch and Warning Systems: Building on the existing WWS in place at the country / territory levels for tropical cyclones, it was discussed that these systems could be extended to other hydro-meteorological and coastal hazards. Coordination among technical agencies, such as hydrological and coastal institutions, was highlighted as a priority to improve multi-sectoral input for multi-hazard warning and decision making. It was specified that the needs of DRM agencies and other stakeholders (lead time, national constraints, etc.) should be taken into consideration for the development of such systems.

    (ii) Regional coordination of watch and warnings: The discussions on the roles and responsibilities of the RSMC Miami Hurricane Center, which facilitates the building of a consensus forecast for tropical cyclones and relays the watches and warnings issued by the countries/territories of the Caribbean in its advisories, highlighted the relevance of such a mechanism for other hazards. In this regard, there is a need to implement real-time watch and warning coordination mechanisms throughout the region for hydrometeorological hazards other than tropical cyclones, based on consensus guidance forecast products, especially in the case of (i) countries/territories with type II relationships, and (ii) for neighbouring countries/territories. Specific SOP would then have to be developed. The sharing of good practices from the region with regard to WWS implementation, in order to assist implementation national level was also discussed.

    (iii) Linkages with other systems such as tsunami: ICG CARIBE/EWS presented the tsunami and coastal hazards warning system for the Caribbean and adjacent regions. The potential linkages between hydrometeorological and tsunami watch and warnings were discussed, and the need for the development of a multi-hazard approach of watch and warning issued at the national levels was stressed. Specifically, coastal inundation and watch and warnings dissemination were highlighted as two potential areas of coordination. It was also recalled that the dissemination of tsunami warnings

through the WMO Global Telecommunication System (GTS) highlights the benefits of such a coordination.

Recommendations

45. The Workshop recommended that the expected outcomes of the Caribbean MHEWS Initiative should include:

    (i) Strengthened real-time coordination at national level with other technical agencies, such as hydrological and coastal institutions, and improved multi-sectoral input for warning and decision making, with impact oriented approach

    (ii) Strengthened national comprehensive, multi-sectoral and multi-level criteria-oriented WWS for the relevant meteorological, hydrological and coastal marine hazards that meet the needs of DRM agencies and other stakeholders (lead time, national constraints, etc.);

    (iii) Implemented mechanisms and procedures for real-time coordination on warnings issuance and end-to-end dissemination at national level between countries and territories (especially among small neighbouring territories), taking into account existing regional systems (RSMC Miami for tropical cyclones, Tsunami Warning Center initiative) and the role of other regional centers.

    (iv) A yearly regional meeting of Meteorological services and Disaster Management agencies is conducted for developing / maintaining coordination mechanisms among the Caribbean Islands

    (v) Enhanced sharing of good practices and transfer of knowledge and experience on WWS in the region through workshops and training

    (vi) Leveraging opportunities across hydrological, meteorological and tsunami warning systems

46. In addition, specific issues related to Type I and II relationships on Monitoring, Forecasting and watch and warning systems that emerged from the discussions are highlighted in Table 9.

3.5. Session 6: Final Synthesis, Recommendations and reflection of International and Regional Funding and Development Agencies

47. The session discussed further the recommendations from the previous thematic sessions and concluded on the expected outcomes of the Caribbean MHEWS Initiative in the following areas: (i) Risk Assessment (ii) Operational Cooperation among NMHSs, DRM Agencies and other EWS technical agencies (iii) Technical Capacities with respect to Observation, Monitoring, and Forecasting, (iv) Overarching Capacities (e.g. QMS, Training, Education, Infrastructure), and (v) WWS and coordination at national and regional level. These detailed recommendations are described in the next section.

48. In the concluding part of session 6, donors from the Finnish Development Agency and IADB gave their reflections on areas they support in MHEWS in the Caribbean region. These include:

    (i) The Finnish Development Agency is heavily engaged in the region through a fund for the calibration of the laboratory at CIMH, and through the Smartmet forecasting workstation (a pilot project in Jamaica, Trinidad and Tobago), for which phase II is currently under way. The question was raised as to how to collaborate with other institutions to bring QMS beyond the aeronautical matter.

    (ii) IADB highlighted the following issues; (i) the importance of quantifying risks for appropriate decision on the design of specific national programmes for risk reduction, (ii) the need to bring together existing capacities from best practice examples in the region to develop integrated multi-sectoral systems, (iii) the need to link DRM to

climate change adaptation, (iv) the question of what kind of IADB funding exists, and how the available funds could be used for national or regional initiatives, such as high resolution bathymetry or the upgrading/implementation of observing networks.

4. Conclusions, Recommendations and Next Steps

49. The participants of the Barbados MHEWS Workshop appreciated Doc 4 and provided feedback so that it becomes a blueprint for the strengthening of MHEWS capacities in the Caribbean.

50. The Workshop also prioritised the findings of this report and recommended that the expected outcomes of the Caribbean MHEWS Initiative should include the following:

On Risk Assessment:

(i) Institutional mapping of stakeholders (national and regional) involved in all aspects of risk assessment including their roles and responsibilities and capacities

(ii) National multi-stakeholder mechanisms developed to support risk assessment

(iii) Developed/strengthened capacities for integrated, quality controlled and sustainable GIS databases with meta-data and climatological (data rescue) and exchange mechanisms at national and regional levels

(iv) Accesses to high resolution topography and bathymetry

(v) Developed/strengthened hazard analysis, mapping and product development capacities through integrated modeling

(vi) Established Regional Climate Outlook Forum

On Operational Cooperation among NMHSs, DRM Agencies and other EWS technical agencies and Service Delivery:

(i) Reviewed and updated policies, legislation and legal frameworks in support of DRR and EWS, based on good practices (e.g. CDEMA legislation models and tools)

(ii) Developed and implemented comprehensive QMS in the Meteorological Services and specific SOP across agencies and within other technical institutions, centered on EWS-user needs and operational cooperation. In this regard territories/countries where the NMS supports another NMS or supports another countries DRM Agency will have specific QMS/SOP for each relationship; This would include:

- Developed risk-based, multi-agency mechanism to identify the needs and requirements for meteorological, hydrological and climate products and services, such as (i) Data Products, (ii) Hazard analysis (statistical and forward looking), (iii) Forecast and warnings, and (iv) Technical Advise and operational support
- Mapping and documenting of multi-sectoral institutional coordination and relationships through established QMS and SOP
- Strengthened dissemination mechanisms among EWS stakeholders, including DRM Agencies and Meteorological and Hydrological Services through (i) Strengthening of regionally harmonized protocols (e.g. CAP) (ii) integrated tools or systems with automated processes, (iii) strengthening of back up systems (including agreements for back up between different countries/territories) and (iv) improvement of the capacities of the Meteorological services for a comprehensive management of their public web sites.
- Enhanced feedback mechanisms in QMS, SOP, exercises and post event evaluations

(iii) Enhanced credibility and impact of live communication on Media through (i) bilateral workshops and training with forecasters and Media specialists and/or journalists; (ii)

specific integrated tools or systems dedicated for TV broadcast, and (iii) targeting specific populations (e.g. tourists, youth)

(iv) Developed multimedia educational programmes and materials on all Hydro-Meteorological and climate related hazards and risks with specific attention to vulnerable groups in society and to local needs, by making use of local examples; through partnership/cooperation with DRM Agencies and other national and international organizations

On Technical Capacities with respect to Observation and Monitoring:

(i) Strengthened observation and monitoring capacities through:

- Improvement of time and space coverage with a special attention to NMS III islands without real-time observation networks;
- Strengthened coordination among technical agencies that manage their own hydro-meteorological networks, for better interoperability and real-time exchange
- Development of sustainability plans for observing networks (e.g. maintenance plan, spare parts, quality control methods, training)
- Improvement of sharing of regional observation data that is crucial for severe weather monitoring, such as radar, wave rider or lightning data;

(ii) Strengthened real-time coordination and collaboration across technical agencies at the national level (meteorological, hydrological, coastal, etc.) for data exchange and multi-sectoral input in forecast and warning process

(iii) Standardized and integrated regional observations networks (based on Carib-HYCOS, Carib WIGOS, Radar project, etc.) and accessibility to every country/territory

On Technical Capacities with respect to Forecasting:

(i) Strengthened and expanded forecasting capacities for all the Meteorological and Hydrological hazards (tropical cyclone and disturbances generating strong winds, heavy rainfall and damaging waves that could create flash floods, landslides, coastal surge and inundation, drought) through:

- Upgraded forecasting system that facilitates easy and integrated access to a wider variety of numerical products (including regional atmospheric and waves models and probabilistic products)
- Implemented intelligent and integrated forecasting guidance systems for severe weather (strong wind, heavy rain, storm surge, damaging waves), flash flood (Flash Flood Guidance System) and drought at regional level
- Forecasters trained in the latest methodologies and analysis techniques, including probabilistic and deterministic model outputs and radar/satellite interpretation for the tropics.

(ii) Role of regional centers are strengthened to provide forecasting guidance tools and products for all meteorological, hydrological and marine hazards and to develop coordination mechanisms

(iii) Strengthened real-time exchange and coordination mechanisms at sub-regional level, especially in the case of neighbouring forecast offices and of NMS II countries/territories

(iv) Strengthened telecommunication networks at regional and national level through:

- Improved transmission systems for dissemination, exchange and data collection at national to regional levels

- Enhanced reliable systems for back-up and redundancy, with specific agreements and SOP among different countries/territories
- Upgraded internet capacities and web management capabilities

On Watch and Warning Systems and coordination at national and regional level:

(i) Strengthened real-time coordination at national level with other technical agencies, such as hydrological and coastal institutions, and improved multi-sectoral input for warning and decision making, with impact oriented approach

(ii) Strengthened national comprehensive, multi-sectoral and multi-level criteria-oriented WWS for the relevant meteorological, hydrological and coastal marine hazards that meet the needs of DRM agencies and other stakeholders (lead time, national constraints, etc.);

(iii) Implemented mechanisms and procedures for real-time coordination on warnings issuance and end-to-end dissemination at national level between countries and territories (especially among small neighbouring territories), taking into account existing regional systems (RSMC Miami for tropical cyclones, Tsunami Warning Center initiative) and the role of other regional centers.

(iv) A yearly regional meeting of Meteorological services and Disaster Management agencies is conducted for developing / maintaining coordination mechanisms among the Caribbean Islands

(v) Enhanced sharing of good practices and transfer of knowledge and experience on WWS in the region through workshops and training

(vi) Leveraging opportunities across hydrological, meteorological and tsunami warning systems

51. The Workshop further recommended that the initiative for the strengthening of MHEWS capacities in the Caribbean should build on and strengthen existing regional cooperation, Centers and coordination mechanisms, such as WMO RA IV RSMC-Miami Hurricane Center and Hurricane Committee, CMO, CIMH (in its various capacities), CCCCC, other relevant CARICOM Centers, UNESCO-IOC ICG CARIBE/EWS, CDEMA/Comprehensive Disaster Management (CDM), CCRIF, and others as relevant.

52. The Workshop noted that its recommendations will be presented and discussed during two high-level meetings in the region:

(i) the 50th Session of the Caribbean Meteorological Council, in Cayman Islands, on November 22nd, 2010, where the Directors of the NMHS of the CMO Members will all participate

(ii) the 5th Caribbean Conference on Comprehensive Disaster Risk Management, in Montego Bay Jamaica on December 6th, 2010, where Directors of the NMHS and DRM Agencies of the Caribbean countries will participate.

LIST OF ACRONYMS

CAP	Common Alert Protocol
CARIB-Hycos	Caribbean Hydrological Cycle Observing System project
CCCCC	Caribbean Community Climate Change Center
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CDEMA	Caribbean Disaster Emergency Management Agency
CIFDP	Coastal Inundation Forecasting Demonstration Project
CIMH	Caribbean Institute for Meteorology and Hydrology
CMO	Caribbean Meteorological Organization
COMET	Cooperative Programme for Operational Meteorology, Education and Training
CRMI	The Caribbean Risk Management Initiative
CRMI	Caribbean Risk Management Initiative
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EWS	Early Warning System
FFGS	Flash Flood Guidance System
FWI	French West Indies
GIS	Geographic Information System
ICAO	International Civil Aviation Organization
IOC/ICG - CARIBE EWS	Intergovernmental Oceanographic Commission / Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions
ISO	International Organization for Standardization
MHEWS	Multi-Hazard Early Warning System
MOU	Memorandum of Understanding
NMHS	National Meteorological and Hydrological Service
NMS	National Meteorological Service
NOAA-NWS	National Oceanographic and Atmospheric Administration - National Weather Service
QMS	Quality Management System
R3I	Regional Risk Reduction Initiative
RA	Regional Association
RSMC	Regional Specialized Meteorological Center
RSMC-Miami	Regional Specialized Meteorological Center - Miami Hurricane Center
SOP	Standard Operating Procedure
SWFDP	Severe Weather Forecasting Demonstration Project
UN	United Nations
UNDP	United Nations Development Programme
UNESCO-IOC	United Nations Educational, Scientific and Cultural Organization Intergovernmental Oceanographic Commission
WIGOS	WMO Integrated Global Observing System
WMO	World Meteorological Organization
WWS	Watch and Warning System

Figures

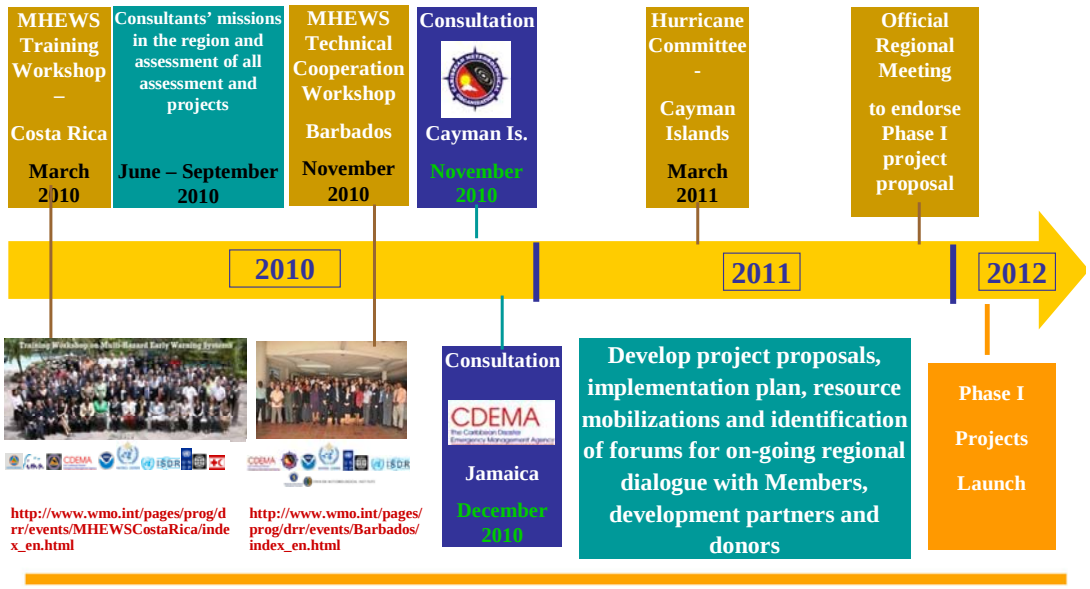

Figure 1: Roadmap for the project design to strengthen Caribbean MHEWS capacities: Consultations, Major Milestones and Timeline

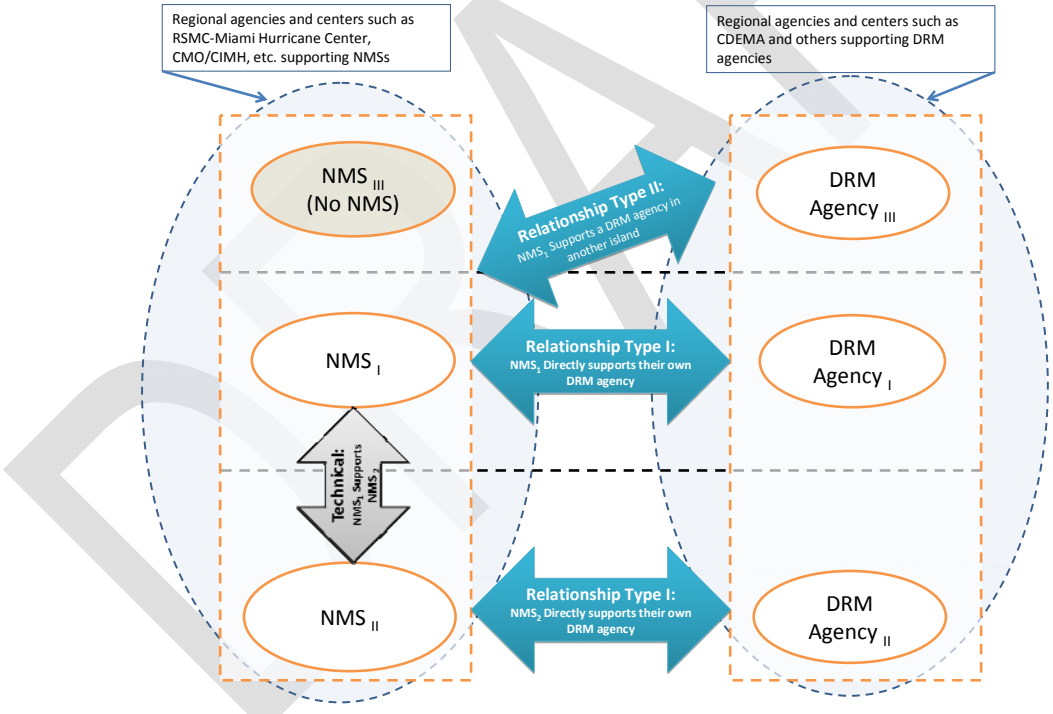

Figure 2: Different relationships between Disaster Management Agencies and Meteorological Services in the Caribbean

Antigua & B.
Bahamas
Barbados
Belize
Cayman
Cuba
Curaçao
Dominican Rep.
Guadeloupe
Guyana
Haiti
Jamaica
Martinique
St Lucia
Suriname
Trinidad & T.

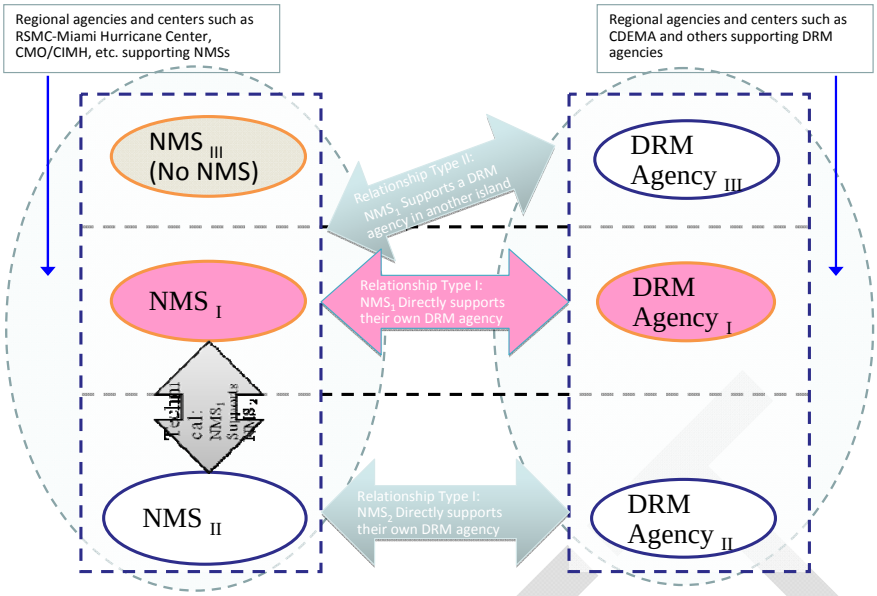

Figure 3: Relationship Type I / NMS I - Countries/territories with Meteorological Service with full capacities to support DRM agencies

Barbados
Dominica
St Vincent & G.
Curaçao
Aruba
St Marteen
Trinidad & T.
Grenada

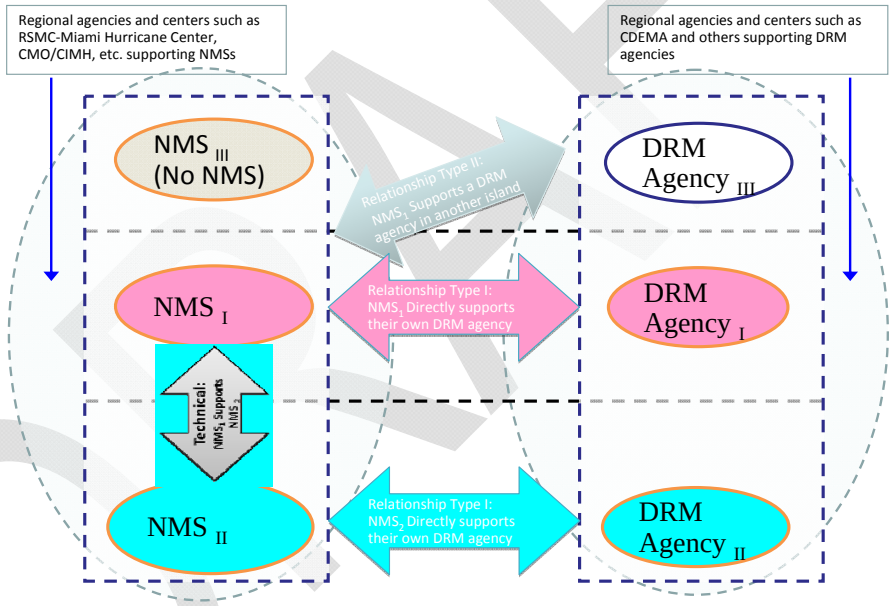

Figure 4: Relationship Type I / NMS I & II -Countries/territories with national or local Meteorological Service, with limited capacities, (e.g. no forecast and warning office) that need support from another island to fulfill their mandate to support the DRM Agency of their country

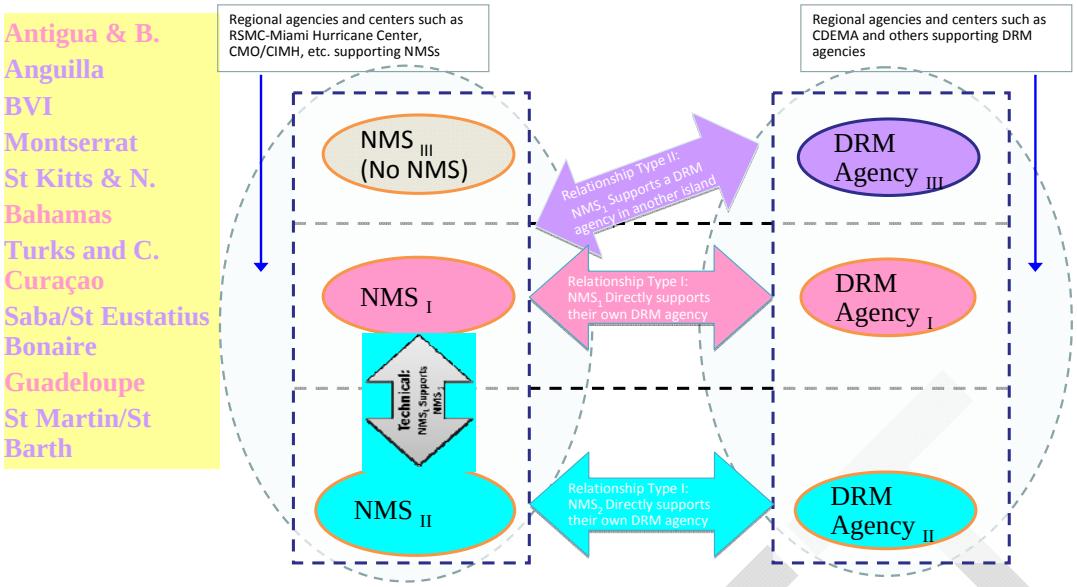

Figure 5: Relationship II / NMS II & III - National or local DRM agency receives support from the meteorological service located in another country/territory

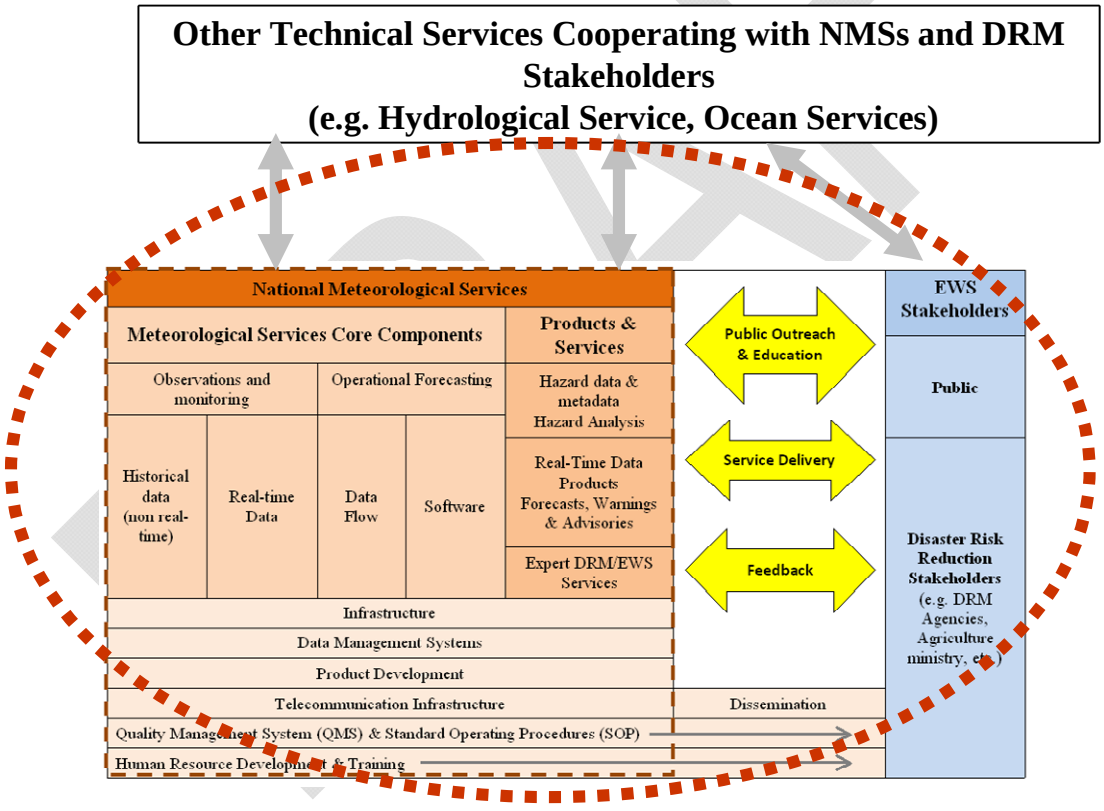

Figure 6: Operational linkages of Meteorological Services with EWS stakeholders and Meteorological Services capacities

The schematic presented above (Figure 6) is an illustration of the core aspects of the support that Meteorological Services provide to DRM agencies and EWS stakeholders. Starting from a user requirements perspective (blue column) the figure illustrates the products and services, core services required to develop these products and services, and the interface between the Meteorological Services and the EWS stakeholders. This interface comprises Public Outreach and Education, Service Delivery as well as Feedback.

Tables

Institution	Dates	Type *	Abbreviations	Title	Countries involved
CDEMA/OAS/JICA/CIDA	2003	S	CHAMP I	HMDMVA : Hazard Maps and Vulnerability Assessments Studies http://www.cdera.org/projects/champ/docs/all_docs.shtml	CDEMA members + Martinique
WMO-DRR	2006	S	WMO2006	Country-Level Disaster Prevention and Mitigation	The Bahamas, Barbados, Cayman Islands, Dominican Republic, Haiti, Jamaica, Dutch West Indies, St Lucia, Trinidad and Tobago
WMO-DRR	2010	S	WMO2010	Multi-Hazard Early Warning Systems with focus on Institutional Partnership and Coordination	Antigua and Barbuda, Bahamas, Barbados, Anguilla, British Virgin Islands, Cayman Islands, Turks and Caicos Islands, Dominica, Dominican Republic, Grenada, Jamaica, Dutch West Indies, St Lucia, Trinidad and Tobago
WMO-DRR	2010	M	WMO_Ews	Training Workshop on Multi-Hazard Early Warning Systems http://www.wmo.int/pages/prog/drr/events/MHEWSCostaRica/index_en.html	All islands in the project
European Union	2010	V	E.U. 2010	Current actions and initiatives in the field of civil protection in order to promote and enhance the regional cooperation mechanism	All islands in the project
UNDP	2010	V	R3I	Regional Risk Reduction Initiative (R3I) http://www.bb.undp.org/index.php?page=regional-risk-reduction-initiative	Caribbean OCTs
CDEMA	2006	V	CDM	CDM Audit	CDEMA members
USAID BTOOL	Since 2008	VS	BT	http://www.cdera.org/cunews/news/antigua/article_2067.php St-Lucia report available at http://stlucia.gov.lc/nemp/	OECS

* V= Visits and interviews; S = Surveys; M = Meetings/Workshops

Table 1: Regional assessments related to MHEWS and DRR in the islands of the Caribbean region

Table 2: Regional assessments related to MHEWS and DRR in the islands of the Caribbean region

Institution	Dates	Type *	Abbreviations	Title	Countries involved
CDEMA/OAS/JICA/CIDA	2003	S	CHAMP I	HMDMVA : Hazard Maps and Vulnerability Assessments Studies http://www.cdera.org/projects/champ/docs/all_docs.shtml	CDEMA members + Martinique
WMO-DRR	2006	S	WMO2006	Country-Level Disaster Prevention and Mitigation	The Bahamas, Barbados, Cayman Islands, Dominican Republic, Haiti, Jamaica, Dutch West Indies, St Lucia, Trinidad and Tobago
WMO-DRR	2010	S	WMO2010	Multi-Hazard Early Warning Systems with focus on Institutional Partnership and Coordination	Antigua and Barbuda, Bahamas, Barbados, Anguilla, British Virgin Islands, Cayman Islands, Turks and Caicos Islands, Dominica, Dominican Republic, Grenada, Jamaica, Dutch West Indies, St Lucia, Trinidad and Tobago
WMO-DRR	2010	M	WMO_Ews	Training Workshop on Multi-Hazard Early Warning Systems http://www.wmo.int/pages/prog/drr/events/MHEWSCostaRica/index_en.html	All islands in the project
European Union	2010	V	E.U. 2010	Current actions and initiatives in the field of civil protection in order to promote and enhance the regional cooperation mechanism	All islands in the project
UNDP	2010	V	R3I	Regional Risk Reduction Initiative (R3I) http://www.bb.undp.org/index.php?page=regional-risk-reduction-initiative	Caribbean OCTs
CDEMA	2006	V	CDM	CDM Audit	CDEMA members
USAID BTOOL	Since 2008	VS	BT	http://www.cdera.org/cunews/news/antigua/article_2067.php St-Lucia report available at http://stlucia.gov.lc/nemp/	OECS

* V= Visits and interviews; S = Surveys; M = Meetings/Workshops

Table 3: Consolidated list of regional programmes or projects relevant to MHEWS

NAME and Abbreviations	Implementing agency	Duration	Goals	Participating Countries	Funding
CARIB-HYCOS (CAR-HY)	WMO IRD	Since 2004	Assist the NMHSs in the modernization and strengthening of their activities related to water resources, so as to provide them with more reliable systems and data for the issuance of more accurate short, medium and long-term forecasts. http://www.caraibes-hycos.org	Antigua and Barbuda, Barbados, Curacao, Dominica, Dominican Republic, French West Indies, Haiti, Jamaica, St Lucia, Trinidad & Tobago	IRD (France) E.U.(Intereg IV) Members 3,5M Euros
US/RAIVWIGOS (RAIV-Wigos)	WMO USA		The proposed US/RA IV WIGOS Demonstration Project (WDP) endeavors to build an Integrated Atmosphere Observing System (IAOS) with enhanced interoperability features through the integration of various component systems representing surface-based upper-air observations such as rawinsondes, airborne observations including AMDAR from RA IV Member countries, and space-based observations derived from satellite soundings. Interoperability will be facilitated through metadata catalogues and archival sites consistent with evolving WIS architecture. http://www.wmo.int/pages/prog/www/wigos/documents/DP_USA.pdf	All the participating islands and countries except Guyana, Suriname which are part of RA III and Grenada, St-Kitts and Nevis and St-Vincent and the Grenadines	
CADM II	CDEMA CIMH	Phase II 2009-2012	To mitigate disaster damages through enhancement of community resilience to the flood hazard. http://www.cdema.org/index.php?option=com_content&view=article&id=111&Itemid=89	CDEMA members Pilot project for Dominica, Grenada, St Lucia, Belize, Guyana	JICA 2,7M USD
CRMI	UNDP	Phase II Since 2010	Umbrella programme designed to build capacity across the Caribbean region for the management of climate-related risk. http://www.undp.org.cu/crmi/en/index.asp Table of documents of reference downloadable at http://www.undp.org.cu/crmi/en/drrdocs.asp	Antigua and Barbuda, Bahamas, British OCTs, Barbados, Cuba, Dominican Republic, Grenada, Haita, Jamaica, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago	Italy, Norway, UNDP 2,8 M USD

NAME and Abbreviations	Implementing agency	Duration	Goals	Participating Countries	Funding
R3I	UNDP	2009-2011	To address the risk and exposure of these small islands by providing a network of regional infrastructure, programmes, policies and protocols to strengthen their capacity to predict and prepare for natural hazards, thus improve resilience and reduce risk and subsequent loss. http://www.bb.undp.org/index.php?page=regional-risk-reduction-initiative	All OCTs	4,9M Euros
SHOCS	Finland ACS	Phase II 2010-2012	Be better prepared for the adverse effects of natural disasters and harmful impacts of climate change. • decrease the number of casualties and economic losses due to natural hazards; • make investments on early warning systems and rescue preparedness; • establish authority of NMHSs and civil protection agencies as contributors to DRR http://www.acs-aec.org/Disasters/18th%20SC%20Disasters/English/SHOCS_ProjectDocument_FMI_ACS_eng.pdf.	ACS Members	
CHAMP II	OAS Cdema	2005 2008	To assist countries in the Caribbean region with the development of comprehensive, national hazard vulnerability reduction initiatives through the development of national hazard mitigation policies, creation of appropriate policy implementation programs through comprehensive hazard mitigation planning frameworks and the development and implementation of safer building training and certificate programs - Hazard Mapping & Common Digital Databases for Hazard Mapping and Vulnerability Assessment; - Quantitative Risk Assessment – QRAP (BVI) http://www.cdera.org/projects/champ/	CDEMA members 4 pilot states : St Lucia, Grenada, British Virgin Islands and Belize	CIDA CDEMA 1,4 M USD
Programmes Information from the E.U. 2010 assessment					
Tsunami EWS	U.W.I	2006 2008	To strengthen the capacity of the Seismic Research Unit to detect, monitor and warn people at risk from tsunami and other related geologic hazards; To launch a comprehensive public education campaign to be coordinated by the CDEMA.	All islands	USAID, Trinidad and Tobago 390.000 USD
Tsunami EWS	U.W.I CDEMA	2007 2009	Increased public awareness about tsunamis and other coastal hazards; Improved notification of tsunamis and other coastal hazards to at-risk population.	All islands	USAID, CDEMA 828.000 USD

NAME and Abbreviations	Implementing agency	Duration	Goals	Participating Countries	Funding
ICT for disaster management	CDEMA	2007 2009	This project aims to enhance the effectiveness of Disaster Management practices in the Caribbean region through the identification and testing of innovative ICT applications including early warning systems for fast onset hazards.	CDEMA members	IDRC 700.000 BDS
ERRVC	UNDP CIMH	2009 2011	Reducing vulnerability and increasing resilience to climate change, natural hazards and poverty at the regional, national and community levels within the Caribbean region.	4 OECS members	Italy 3,5M Euros
Carib Cluster for Natural Risks	Region Martinique	2008 2010	Identification of main actors, sensitization of the actors to the project, mobilization and involvement of the interested actors; Establishment of groups of experts. Screening of projects and initiatives with innovative approaches. Internet and directory support to actors and initiatives The main themes are GIS, the sea (Tsunami, coastal erosion), seism, floods and drought .	Cuba, Dominica, Haiti, Jamaica , Dominican Republic, St Lucia, Trinidad and Tobago, the French West Indies and Guyana	Intereg IV Martinique 865.000 Euros
Enhancing Disaster Preparedness	Oxfam GB	2009 2011	To contribute to disaster risk reduction in the Caribbean region by enhancing knowledge management of disaster preparedness integration in rural livelihoods and urban planning among community leaders, local Governments and other key stakeholders.	Special focus on Haiti and Jamaica	Echo-Dipecho 700.000 Euros
Mainstreaming Adaptation to Climate Change Project	CCCCC	2003 2009	The objective is to facilitate the creation of an enabling environment in the small islands and coastal developing states of CARICOM for climate change adaptation.	CDEMA members	World Bank
Implementation of Adaptation Measures in Coastal Zones	Countries	2006 2011	To implement specific (integrated) pilot adaptation measures addressing primarily, the impacts of climate change on their natural resource base along coastal and near-coastal areas; To produce knowledge of global value on how to implement adaptation measures in small island states that can be applied in other countries in the region.	Dominica, St Lucia, St Vincent and the Grenadines	World Bank GEF Project 5,5 M USD
Mainstreaming Disaster Risk Management		2010	The first component will engage local communities by implementing demonstrative community risk reduction projects; The second component will help to build capacity in key stakeholders in member states of the OECS concerned with planning and implementation of development projects. The technical cooperation will make significant use of some of the disaster risk management tools that have been developed in the region:	OECS	IADB 400.000 USD

NAME and Abbreviations	Implementing agency	Duration	Goals	Participating Countries	Funding
			http://www.iadb.org/projects/project.cfm?id=RS-T1319&lang=en		

Table 4: List of Countries/Territories that Responded to the Questionnaire

	Country/Territory	Response to Questionnaire	Response to CAP Survey
1	ANTIGUA AND BARBUDA	Yes	Yes
2	ARUBA	Yes	No
3	BAHAMAS	No	No
4	BARBADOS	No	No
5	BELIZE	No	No
6	CUBA	No	No
7	CURACAO	Yes	Yes
8	DOMINICA	Yes	Yes
9	DOMINICAN REPUBLIC	No	No
10	FRENCH WEST INDIES	No	No
11	GRENADA	No	No
12	GUYANA	No	No
13	HAITI	No	No
14	JAMAICA	No	No
15	SAINT KITTS AND NEVIS	No	No
16	SAINT LUCIA	No	No
17	ST VINCENT AND THE GRENADINES	No	No
18	SURINAM	No	No
19	TRINIDAD AND TOBAGO	Yes	Yes
TERRITORIES			
BRITISH OVERSEAS TERRITORIES			
20	ANGUILLA	No	No
21	BRITISH VIRGIN ISLANDS	No	No
22	CAYMAN ISLANDS	Yes	Yes
23	MONTSERRAT	Yes	Yes
24	TURKS AND CAICOS ISLANDS	Yes	Yes
CARIBBEAN NETHERLANDS			
25	BONAIRE	No	No
26	ST EUSTATIUS	Yes	No

Table 5: Summary of responses to the questionnaire on the top priority areas for national development

Themes	Priority Areas
NMHS and DRM Operational cooperation and Service Delivery	▪ Establishment of QMS for all areas of Meteorological Services and the DRM Agencies ▪ Improvement of the legislative framework (e.g. policies, MoU, SOP) ▪ Networking and information sharing mechanisms among EWS stakeholders ▪ Operational cooperation between Meteorological Services and DRM agencies
Risk Analysis	▪ Training of personnel in risk assessment, data analysis, hazard mapping, GIS, damage assessment, data management systems, etc. ▪ Procurement of equipment for the development of better data management systems and more accurate hazard risk maps
Forecasting capacities	▪ Enhancement of forecasting capacities, to international standards, through training of forecasters and increased human resources to ensure 24-hour operationally ▪ Enhancement of marine forecast models ▪ Hardware and software upgrades of GTS equipment ▪ Strengthening backup and fall-over capacities
Monitoring	▪ Expanded observational coverage through improvement and strengthening of the Automatic Weather Station (AWS) network, with increased capacity for real-time data transmission ▪ Increased human resources and training, including more weather observers and maintenance personnel for observation equipment. ▪ Increased regional and EWS stakeholder sharing of meteorological observations ▪ Training for personnel to take stream flow measurements ▪ Standardization of all meteorological observation equipment.
Coordination of watch and warnings	▪ Strengthening of coordination between EWS stakeholders through the establishment of MoUs and SOPs and regular technical meetings ▪ Training for staff members on newer responsibilities such as such as Tsunami watches and warnings ▪ Increased regional coordination and harmonization of watch warning systems

Table 6: Session 3 Working Group Outcomes for "Operational Cooperation of NMHS and DRM Agencies and Service Delivery for MHEWS"

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
Need for additional resources for the development of legislation on MHEWS and specifically the NHMS and DRM agencies relationship.	Need for national government to facilitate a framework (e.g. legislation) for EWS stakeholder relationships (Political Buy-in)	Lack of clear legal framework for cooperation between different countries/territories, especially with type II relationships
Need for strengthening the cooperation, coordination and communication (especially highlighted by Guyana and Belize) for the development and issuance of warnings to and advisories through the DRM agencies to different levels of the national community	Need capacity development for implementation of QMS that documents the relationship between the Meteorological Services and DRM agency including formal documentation (MoU, SOP, etc) of: 1) relationship type I with NMS II (Meteorological service supporting another Meteorological Service) 2) relationships among DRM agencies and technical services (e.g. Meteorological / Hydrological / coastal Services)	Need for identification of different structures (e.g. focal points) and all the stakeholders in different countries/territories in the region;
Need for the development/enhancement of QMS and SOP to cover all aspects of DRM.	Need for a more formalized sharing of hydrometeorological data & information through defining protocols of data and information exchange (e.g. MoU, SOP) among EWS stakeholders	Need for updating/developing written operational procedures and SOP under a comprehensive QMS that could be developed, through a regional project that could assist countries/territories to adapt SOPs/QMS to their own needs
Need for strengthening/developing, in most countries their capacities (infrastructure, planning and preparedness) with regard to tsunami warnings	DRM agencies expressed a need for better understanding of products and services available from meteorological and hydrological services	Need for the development of a QMS to cover each relationship type (e.g. countries managing several type I and II relationships)-

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
	Need for strengthening a user focused product development mechanism for the Meteorological Services	Some islands are supported by a distant NMS can cause confusion for the public.
	Need for strengthening mechanisms for near real-time and real-time coordination and collaboration between the Meteorological Service and Disaster risk Management agency	Need for a wider adoption of CAP to facilitate clarification of who is responsible to issue what information to whom through what mechanism throughout the region. Leveraging the pilot project in Anguilla could be considered.
.	Need for specialized training for: 1) Disaster managers on interpretation and use of hydrometeorological tools and products; 2) Meteorologists on disaster management processes and needs and on presentation of hazard information to media and public; 3) Meteorologists on use of new technologies and methods	Need for strengthening the capacities of NMSs to understand the needs and requirements of DRMs, Media and other EWS stakeholders
	Need for strengthening audience communication and feedback mechanisms capacities of NMS, DRM and other stakeholders in EWS	Need for strengthening/developing capacities at NMS level for website management and email services including product development, 24x7 update, mirror sites, etc. (especially for shared web site)
.		Need to strengthen critical facilities for dissemination and communication, redundancy, and backup systems.

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
		Need for strengthening capacities for effective communication between NMSs, media and the DRMs including: - Targeting specific populations with regard to communication of warnings (e.g. tourists speaking different languages, the young population) - Strengthening the use of news forms of dissemination (e.g. SMS, social networks) taking into consideration the credibility/reliability of information
		Need for strengthening of Public Education and Outreach through training of NMS staff, media and DRM agencies on their respective capacities, limitations and terminologies

Table 7: Session 4 Working Group Outcomes for "Risk Analysis, Data Management and Exchange"

WORKING GROUP A **(NMS I , Type I relationships)**	**WORKING GROUP B** **(NMS I + II, Type I relationships)**	**WORKING GROUP C** **(NMS I + III, type I + 2 relationships)**
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
Need for development of multi-agency data and sharing policies among EWS stakeholders	Need for a integrated approach at the national level that involves all stakeholders, defines their roles and relationships and defines their data policies (e.g. water resource management, real-time data accessibility)	Need for strengthening/development of data management, hazard assessment and risk mapping for NMS type III countries (No Meteorological Service)
Need for identification of national hazard and socio-economic data centers (agencies, institutions, private companies, etc.) and accessibility of the data.	Need for more representative and robust observation network through: - Adequate spatial and temporal coverage - Sustainability plan (e.g. maintenance plans, replacement parts, quality control methods, and training)	Need for better understanding by supporting NMSs of the high priority hazards for supported islands (NMS type I & III) as well as their associated vulnerabilities.
Need for strengthening/developing EWS observation data management such as: - Real-time sharing of rainfall data; - Access to historical data - Access to data on topography and bathymetry	Need for institutionalizing arrangements (MoUs, SOPs, legal frameworks) for data, product and methodologies sharing (e.g. observation data, model data and products, Climate data)	Need for enhancing observation data availability in both space and time
Need for the inclusion of social sector data and information in risk assessments.	Need for development/strengthening of data rescue capacities and processes (including quality control processes) to fill in the historical observation gaps	Need for mapping the status and accessibility of data and metadata through an inventory of meteorological, hydrological, and hazard data available in the region

WORKING GROUP A **(NMS I , Type I relationships)**	**WORKING GROUP B** **(NMS I + II, Type I relationships)**	**WORKING GROUP C** **(NMS I + III, type I + 2 relationships)**
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
Need for a legal framework in most countries to develop risk mapping process with all the stakeholders (currently, hazard mapping, often in coarse resolution, is used interchangeably with risk mapping)	Need for upgrading IT infrastructure (hardware & software) for data management, collection of data, hazard analysis and model analysis (downscaling), etc.	Need for mapping the institutions responsible for acquiring hazard data and storage (hazard database(s)
Need strengthening/developing tools and methodologies for risk modelling and risk assessment through: - sharing of good practices in the region (Cuba, Jamaica) - enhancing the role of Meteorological and DRM regional centers for training	Need to enhance coordination, standardization and sharing of observation data projects (e.g. multiple observation projects by different owners, such as private companies or different governmental agencies, with differing standards and stakeholders)	Need for structured mechanisms through specific agreements, at country/territory and regional levels, to strengthen collaborative relationships (i.e. exchange, sharing and access) among institutions which manage meteorological and hydrological data.
	Need for the widening of the scope (Caribbean-wide) of CIMH with regard to centralized meteorological data collection/repository (CIMH is limited to CMO members)	Need for upgrading and harmonization of software for data management and archiving
	Need for strengthening hazard risk analysis capacities, such as: - data requirements for effective hazard analysis - integration of different production systems to produce hazard maps, forecast maps, warning maps, atlases	Need for development of a comprehensive hazards database (past storms, land slides etc.) that includes hazard specific information as well as impacts
	Need for development/strengthening of national structures for development of products that include the integration of vulnerability data and hazard data	Need for capacity development mechanisms for data rescue methodologies and tools such as training workshops through regional cooperation and the relevant WMO programme
	Need for pooling of resources at the regional level (center of excellence) for high level processing (e.g. hazard modelling) of regional and national data	Need for data quality control mechanism and methodologies

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
	Need for capacity training on: - Data management; - Equipment maintenance; - Building historical databases (data rescue); - Methodologies for implementation of metadata; - Product development; - Utilization of modelling outputs; Integration of observation data (radar, satellite, surface, etc.)	Need to extend data management and sharing to wider variety of data (e.g. rainfall accumulation radar data, coastal marine observations)
	Need for a list of resources that are available in the region including: Modelling; Training; Product development	Need to strengthen/develop a regional programme for acquisition or access of high resolution database for topography and bathymetry
		Need for strengthening capacities for downscaling of hazard mapping information (flash floods, land slides etc.)
		Need for enhancing the exchange of hazard information from island to island especially in the case of type 2 relationships
		Need to enhance the capacities for risk modelling through access to modelling facilities under regional cooperation with a focus on flooding, coastal inundation (storm surge, tsunami and damaging waves) and land slides.
		Need for strengthening software and methodologies for hazard and risk modelling capacities through training of NMHSs and DRM agencies

Table 8: Session 5 Working Group Outcomes for "Issues, Challenges and Opportunities for Harmonization, Exchange and Real time Coordination of Hydro-Meteorological Observation Monitoring Networks, Forecasting Expertise and Watch and Warning Systems"

WORKING GROUP A **(NMS I , Type I relationships)**	**WORKING GROUP B** **(NMS I + II, Type I relationships)**	**WORKING GROUP C** **(NMS I + III, type I + 2 relationships)**
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
	MONITORING	
Need for strengthening monitoring and warning capacities through the strengthening of monitoring network (especially rain gauges, hydrological equipment) and coupled real time warning systems	Need for strengthening of real-time observation exchange and access among MHEWS technical agencies under a cooperation framework that ensures efficient and timely monitoring	Need to strengthen the collaboration among the small islands (especially in those of type 2 relationships) for the harmonization of weather observation and monitoring equipment
Need for the improvement of radar data sharing for the entire region	Need for QMS for observation systems and processes (e.g. especially with regard to sustainability plans for the networks, standardization of observation equipment and data)	Need for increased coverage, variety and frequency of radar data for sharing throughout the Region and upgrading to Doppler radar systems
	Need for a national central collecting repository for collecting and provision of monitoring data	Need for capacity enhancement (e.g. training, equipment) to ensure that all data from automatic weather stations is transmitted in real time throughout the Region (e.g. on the GTS)
	Need for refresher training for observers at non-automatic observation stations	Need for increasing the number of webcams as new monitoring instruments
	Need for training on radar and satellite interpretation	
	FORECASTING	

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
Some countries (such as Suriname or Cuba) require equipment and software upgrades for monitoring and forecasting	Need for access or development of capacities for higher resolution models (> 4KM resolution) to capture localized features	Need for strengthening modelling capacities through better access to NWP model products especially for localized forecasts and coastal marine forecasts
Need for strengthening capacities for mesoscale numerical models implementation (such as in Cuba) or access (through regional or/and international centers) with integrated system for display and expertise	Need for strengthening model interpretation skills and communication of probabilistic forecasts to EWS stakeholders and the public	Need for capacity development for the development of a mechanism for developing consensus forecast and guidance products for non-tropical cyclone forecasts
Need for capacity development to improve climate forecasts for slow onset hazards, especially for drought monitoring	Need for assessment and selection of existing and appropriate storm surge/wave models to be used at the national level	Need for redundancy and back-up for reception of forecasting and monitoring information in NMHSs
Need for more timely forecast for planning and coordination purposes	Need for training on upper air sounding indices that are appropriate for tropical forecasting (e.g. LCL, SWAT, Total Totals)	Need to enhance distance learning while ensuring adaptation to local needs
	Need for regional climate services to support the national climate requirements and to facilitate their interpretation and utilization through training	Need for training through cross attachment and exchange of forecasters between NMHSs
	Need for training of forecasters in countries/ territories without forecasting capabilities	Need for training in: Marine meteorology; Communication skills and media issues; Climatology; Information Technology (IT)

WORKING GROUP A **(NMS I , Type I relationships)**	**WORKING GROUP B** **(NMS I + II, Type I relationships)**	**WORKING GROUP C** **(NMS I + III, type I + 2 relationships)**
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
	Need for familiarization of forecasters with countries/ territories for which they have responsibility (NMS I <-> NMS II)	Need for expanding the scope of CIMH that allows training and interaction among non-CMO members
WATCH and WARNING SYSTEMS and COORDINATION		
Need to reinforce dialogue (i.e. communication and coordination) of NMS and NHS with EWS-stakeholders in order to better understand and incorporate their needs in terms of forecast and warning (e.g. lead time, localization, frequency of information)	Need for the development of protocols and zones of elevated monitoring and alerts for each island for disaster management authorities	Need for strengthening of real-time coordination mechanisms between NMHS/NMHSs; NMHS/DRMs; and DRMs/DRMs considering islands where: - NMHSs are not 24/7 operational - NMHSs supports DRM agency in another country; - There is a frequent turn-over of staff; - There is difficulty to contact focal points when required
Need for capacity enhancement to ensure that forecast and warning products are designed or adapted to DRM stakeholders and other agencies, in accessible language, in order that they be most useful within the warning production and delivery process	Need for institutionalizing warning and watch coordination mechanisms among the Caribbean Islands	Need for development of SOPs for real time coordination for each relationship I and II, involving DRM agencies, NMHSs and Focal Points and to update them as frequently as needed (especially the focal point lists)
Need for improvement of the timeliness of NMS warning/advisory forecasts especially when NHS input is required for potential flooding.	Need for a yearly regional meeting of Meteorological services and Disaster Management agencies for developing / maintaining coordination mechanisms among the Caribbean Islands	Need for the strengthening of national and regional coordination mechanisms through enhancing the role of regional centers in watch and warning guidance and coordination especially for non tropical cyclone events

WORKING GROUP A (NMS I , Type I relationships)	**WORKING GROUP B** (NMS I + II, Type I relationships)	**WORKING GROUP C** (NMS I + III, type I + 2 relationships)
GAPS & NEEDS	***GAPS & NEEDS***	***GAPS & NEEDS***
Need for strengthening dialogue and coordination between NMS type I & II, especially in case of non tropical cyclone events	Need to strengthen regional coordination mechanisms between NHMS and DRM agencies among the Caribbean islands through inclusion of: - disaster management agencies in CMO meetings - Meteorological Services in CEDMA conferences	Need for strengthening communication and coordination between neighbouring forecast offices
Need for identification and provision of guidance on good practices on WWS throughout the region and to encourage sharing	Familiarization training of forecasters with countries/ territories for which they have responsibility (Type II relationship)	Need for the development, at national level, watch and warning systems that meet the needs of DRM agencies and other stakeholders (lead time, national constraints in responding to threat), aligned to existing regional warning system
Need to strengthening of communication skills to improve communication to the media and the public with regard to forecast and warning		Need for the development of a watch and warning system at national level for tsunami, based on regional warning system and roles and responsibilities of national focal points.
Need for the improvement of sensitization of population with regard to the meaning of warning flags and advisories through dedicated educational programmes		

Table 9: Synthesis of Working Group outcomes grouped according to relationship types I & II

Operational Cooperation of NMHS and DRM Agencies and Service Delivery for MHEWS	
Specific Needs and Gaps common to NMS I + II and Type I relationships	**Specific Needs and Gaps common to NMS I + III, type I + 2 relationships**
GAPS & NEEDS	***GAPS & NEEDS***
Need specific QMS that documents - relationship type I with NMS II (Meteorological service supporting another Meteorological Service) - relationships among other technical services in the country (e.g. Hydrological / coastal Services) and the NMS that support the country	Need for clear legal framework for cooperation between different countries/territories with type II relationships and to establish who is responsible to issue what information to whom through which way and protocol
Need for a more formalized sharing of hydrometeorological data & information through defining protocols of data and information exchange (e.g. MoU, SOPs) among EWS stakeholders and NMS supporting the country/territory	Need to develop specific SOPs in the QMS of the NMS I to document each relation ship of type I and II, in alignment with SOPS or plans of supported countries/territories, with a special focus on operational cooperation, coordination mechanisms and role of the "focal points"
DRM agencies expressed a need for better understanding of products and services available from the supporting NMS in another country/territory	The fact that some islands are supported through political affiliation by the NMS which is not the closest to them leads to confusion
Need to establish feedback mechanism from the DRM agency and the NMS to the supporting NMS	Need to improve capacities of NMSs to understand the needs of DRM agencies and EWS stakeholders in the other countries/territories they support
	Need to strengthen/develop capacities at NMS level for website management for all the countries/territories that they support (shared web site)
	Need to ensure critical facilities for dissemination and effective communication are in working order, between NMS I and all the NMS III, with full redundancy, and backup systems (especially just before high impact weather)

	Need for specific comprehensive training of the "focal points" in NMS III on MHEWS activities
Risk Analysis, Data Management and Exchange	
Specific Needs and Gaps common to NMS I + II and Type I relationships	**Specific Needs and Gaps common to NMS I + III, type I + 2 relationships**
GAPS & NEEDS	***GAPS & NEEDS***
Need for institutionalizing arrangements (MoUs, SOPs, legal frameworks) to support risk assessment in countries/territories with NMS II (data archiving and rescue, data and hazard products, methodologies, interpretation) from NMS I capacities	Specific issues for data management, hazard assessment and risk mapping in countries/territories with NMS III (No Meteorological Service) need to be addressed with the help of NMS I that support them
Need for pooling of resources at the regional level (center of excellence) to support NMS II with regard to all the activities related to risk assessment.	Need to identify in countries/territories NMS III who is responsible of meteorological and hydrological data management and exchange
	Priorities with regard to hazards among the islands as well as vulnerability is specific to each island; that requires enhanced relationship between countries NMSI and NMS III on all the MHEWS challenges
	Need to strengthen exchange of hazard and risk information from island to island in case of type 2 relationships
Issues, Challenges and Opportunities for Harmonization, Exchange and Real time Coordination of Hydro-Meteorological Observation Monitoring Networks, Forecasting Expertise and Watch and Warning Systems	
Specific Needs and Gaps common to NMS I + II and Type I relationships	**Specific Needs and Gaps common to NMS I + III, type I + 2 relationships**
GAPS & NEEDS	***GAPS & NEEDS***

Need to strengthen the real-time observation exchange and access among MHEWS technical agencies , NMS II in the country/territory and the supporting NMS I under a cooperation framework that ensure efficient and timely monitoring	Need to strengthen the collaboration among the small islands (especially in NMS III) for the harmonization of weather observation and monitoring equipment
Need to strengthen data availability and space/time coverage of observing/monitoring network especially in NMS II, with real-time access from NMS I	Need to strengthen data availability and space/time coverage of observing/monitoring network especially in NMS III, with real-time exchange in case of relationship type II
Need for training in radar and satellite interpretation oriented for observers use in NMS II and for training of more forecasters in NMS II where only one or two of the staff is qualified	Need to strengthen modelling capacities for multi-country localized forecasts (including coastal marine forecasts) in the NMS I
Need to improve, in NMS II, skill in interpretation, use and communication of probabilistic forecasts issued by the supporting NMS I	Need for redundancy and back-up for dissemination/reception of monitoring, forecasting and warning information between NMS III and supporting NMS I
Need for regional climate services to support the national climate requirements and to facilitate their interpretation and utilization through training, especially in NMS II where the are issues with resources	Need to strengthen real-time coordination mechanisms between NMS I / Focal points, NMS I / DRMs and DRMs/DRMs considering: - Frequent turn-over of staff; - Difficulty to contact focal points when required
Need to strengthen modelling capacities for multi-country localized forecasts (including coastal marine forecasts) in the NMS I	Need to develop SOPs on both NMS I and NMS III sides, in the WWS, for real time coordination involving DRM agencies, NMHSs and Focal Points and to update them as frequently as needed (especially the list of contact)
Need to strengthen familiarization of forecasters with countries/ territories for which they have responsibility (NMS I <-> NMS II)	Need to develop in NMS III, at national level, a WWS that meets the needs of DRM agencies and other stakeholders (lead time, national constraints in responding to threat), and that is aligned with regional WWS and capabilities of the supporting NMS I
Need for NMS I to develop protocols and zones of elevated monitoring and alerts to disaster management authorities for each supported country/territory	Need for a yearly regional meeting of Meteorological services and Disaster Management agencies for developing / maintaining coordination mechanisms among the Caribbean Islands
Need for redundancy and back-up for dissemination/reception of monitoring, forecasting and warning information between NMS II and supporting NMS I	

Need for institutionalizing warning and watch coordination mechanisms between NMS I and NMS II	
Need to strengthen regional coordination mechanisms between NHMS and DRM agencies among the Caribbean islands through inclusion of - the disaster management agencies in CMO meetings - the Meteorological Services in CEDMA conference	

Annexes

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Agenda

Technical Cooperation Workshop for Development of the Caribbean Regional Cooperation Programme in Multi-Hazard Early Warning System,

Accra Beach Hotel and Spa
Rockley, Christ Church, Barbados
2-5 November 2010

http://www.wmo.int/pages/prog/drr/events/Barbados/index_en.html

Early Registration ***Outside of Conference Room Khairoon - Monday 1 November 2010 (3:00 - 6:30 pm)***	
➢ **Day 1 – Tuesday 2 November 2010**	
0730 – 0900	Registration - Outside of Conference Room Khairoon
Session 1: Opening and introduction **Room: Khairoon**	
0900 – 0930 0930 - 0945	➢ Welcome remarks and opening session ➢ *Mr. Hampden Lovell, Director, Meteorological Services of Barbados, Permanent Representative of Barbados with WMO* ➢ *Dr. Maryam Golnaraghi, WMO, on behalf of WMO Secretary General* ➢ *Mr. Jeremy Collymore, CDEMA* ➢ *Mr. Stein Hansen, UNDP* ➢ Background, objectives, structure and working arrangements of the Technical Workshop - *Dr. Maryam Golnaraghi (WMO)*
0945 – 1000	**Group photo**
1000 - 1015	**Coffee break**
Session 2: Review of the assessment of the institutional capacities, gaps and needs in MHEWS in the Caribbean **Room: Khairoon** ***Chair: Mr. Hampden Lovell (Permanent Representative of Barbados with WMO)***	
1015 - 1045	➢ Review of the Outcome of the Assessments and Consultations for Development of the Caribbean Regional MHEWS Programme and Priorities for Phase I project - *Maryam Golnaraghi (WMO) with James Douris and Jean-Noel Degrace (WMO Consultants) (20 mins)* ➢ Preliminary results of the Telecommunications Survey in the Caribbean conducted by NOAA-NWS - *Mr. Dan Beardsley (NOAA-NWS) (10 mins)*

1045-12:15	• **Panel 1: Strategic priorities of the Caribbean region in DRR and Meteorology/Hydrology/Climate and Tsunami early warning systems related issues and regional reflections on the outcomes of the assessments and consultations** ➢ *Ms. Andria Grosvenor, CDEMA (10 Mins)* ➢ *Dr. José Maria Rubiera Torres - Representing Mr. Arthur Rolle, President of WMO Regional Association IV (10 mins)* ➢ *Mr. Glendell De Souza - CMO (10 mins)* ➢ *Mr Alexandre Vacher (UNDP Caribbean Risk management Initiative and R3I project) (15 Mins)* ➢ *Experts from non-CMO/CDEMA members will be invited to reflect on the findings of the assessment (as part of the discussions)*
1215 – 1330	**Lunch**

Session 3: Operational Cooperation of the National Meteorological and Hydrological Services (NMHS) and Disaster Risk Management (DRM) Agencies and Service Delivery for MHEWS (National and regional perspectives) (Continued)

Room: Khairoon

This session involves a panel presentation/discussion on good practices using Quality Management Systems and Standard operating procedures engaging the NMHS and DRM stakeholders for meeting user needs. Issues span processes for identification of EWS stakeholders and their needs, forecast and warning product and service development, communication and dissemination of warnings, Common Alert Protocols (CAP), feedback mechanisms for continual improvements of EWS. Following the panel, the participants will be divided into three working groups to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts and identify priorities for strengthening these areas to be addressed in the Caribbean MHEWS regional programme. Also the working groups will provide concrete recommendations for high priority activities to be included in the phase-I project, building on relevant existing projects and activities, and institutional capacities in the region. A list of the participants in each working group will be shared at the Workshop.

Chair: Dr. Maryam Golnaraghi - WMO

1330 – 1530 **Room: Khairoon**	• **Session 3 - Panel 2: Operational Cooperation of NMHS and DRM Agencies: Challenges and Opportunities** ➢ *Presentation of the common gaps, needs and priorities identified in the analysis of the assessments projects and consultations with the participating countries/territories and regional agencies - (Dr. Maryam Golnaraghi (WMO) with James Douris and Jean-Noel Degrace (WMO Consultants) (5mins)* ➢ *Finnish experience with operational cooperation of Finnish Meteorological Service and DRM Agency of Finland and development of Quality Management Systems (Dr. Martti Heikinheimo, FMI) (15 Mins)* ➢ *French West Indies experience with operational cooperation of Météo-France and French Civil Security and QMS (Lt-Col Philippe Cova, Civil Security and Ms Daniele Carnino, Météo-France) (15 mins)* ➢ *Opportunities for strengthening NMHS/DRM operational cooperation: Experiences from the USA (Mr. Lynn Maximuk- NOAA-NWS) (15 mins)* ➢ *Training Programmes across NMHS and DRM agencies (Mr. Patrick Parrish, Comet) (10 Mins)* ➢ *Common Alert Protocols (Eliot Christian, WMO) (10 Mins) – via Video* ➢ *Capacity development in Service delivery framework of NMHS to DRM Agencies in the Caribbean, (Samuel Muchemi, WMO) (15 mins)*
1530 – 1600	**Coffee break**

Session 3: Working Groups			
1600 - 1900	**Working Group A** ***Facilitators**: Jennifer Milton* ***Rapporteurs**: Glendell De Souza, Omar Afflick,* ***Secretariat Support staff**: Charles Baubion, Oscar Arango*	**Working Group B** ***Facilitators:** Sergio Pasquini* ***Rapporteurs:** Sonia Nurse, Danielle Evanson,* ***Secretariat Support staff:** James Douris*	**Working Group C** ***Facilitators:** Lynn Maximuk* ***Rapporteurs:** Alexandre Vacher, Sahar Safaei, Alfredo Capello, Philmore Mullen* ***Secretariat Support staff:** Samuel Muchemi, Jean-Noel Degrace*
➢ **Day 2 – Wednesday 3 November 2010**			
0900 – 1300	**No meeting is scheduled in recognition of the State Funeral for the Late Prime Minister of Barbados, the Honourable David J. H. Thompson**		
1300 – 1400	**Lunch**		

Session 3: Operational Cooperation of the National Meteorological and Hydrological Services (NMHS) and Disaster Risk Management (DRM) Agencies and Service Delivery for MHEWS (National and regional perspectives) – Continued

Chair: Dr. Maryam Golnaraghi - WMO

1400 - 1500 **Room: Khairoon**	• **Session 3 - Plenary Discussions on the outcomes of the Working Groups** ➢ *Presentation by Rapporteur of Working Group A (15 Mins)* ➢ *Presentation by Rapporteur of Working Group B (15 mins)* ➢ *Presentation by Rapporteur of Working Group C (15 mins)* ➢ *Final discussions on the recommendations from session 3*

Session 4: Risk Analysis, Data Management and Exchange Issues to support DRM and EWS with Multi-Hazard Approach (National and regional perspectives)

Room: Khairoon

This session involves a panel presentation/discussion on risk analysis and data management and exchange issues. Experiences and examples in hazard analysis and risk assessment and modelling from the region will be presented. Challenges and needs for strengthening this capacity from perspective of data availability, quality and exchange, hazard and risk modelling tools and need for cooperation and training will be explored. The participants will then be divided into three working groups to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts and identify priorities for strengthening these areas to be addressed in the Caribbean MHEWS regional programme. Also the working groups will provide concrete recommendations for high priority activities, to be included in phase-I project building on relevant existing projects and activities in the region. The working group will have the same membership as in previous session.

Chair: Mr. Niels Holms-Nilesen, The World Bank

1500 – 1700 **Room: Khairoon**	• Statement from Saint Lucia on the impacts on Tomas – • Statement from St Vincent and Grenadines on the impacts on Tomas - • **<u>Session 4 - Panel 3: Challenges for capacity development in hydro-meteorological risk analysis Good practices and examples of good practices</u>** ➢ *Presentation of the common gaps, needs and priorities identified in the analysis of the assessments projects and consultations with the participating countries/territories and regional agencies - (Dr. Maryam Golnaraghi (WMO) with James Douris and Jean-Noel Degrace (WMO Consultants) (10 mins)* ➢ *Experience with development of probabilistic risk modeling in Caribbean and other regions and experience and challenges in Data Management systems (Mr. Galen Evans and Ms. Sahar Safaie - World Bank) (20 mins)* ➢ *Drought Risk Assessment – (Mr Adrian Trotman, CIMH) (15 Mins)* ➢ *Application of Risk Analysis and Modeling in the insurance sector (Ms. Ekhosuehi Iyahen, CCRIF) (15 mins)* ➢ *Reflections in support of Hazard and Risk analysis in the Caribbean: (5 mins reflection)*

	- *Carib-Hycos (Dr. Jean-Pierre Bricquet)* - *RAIV WIGOS Task Team (Mr. Glendell De Souza)* - *WMO (Maryam Golnaraghi)*
1700 - 1715	**Coffee break**

Session 4: Working Groups

1715 - 1930	**Working Group A**	**Working Group B**	**Working Group C**
	***Facilitators**: Jennifer Milton* ***Rapporteurs**: Glendell De Souza, Omar Afflick,* ***Secretariat Support staff**: Charles Baubion, Oscar Arango*	***Facilitators:** Sergio Pasquini* ***Rapporteurs:** Sonia Nurse, Danielle Evanson,* ***Secretariat Support staff:** James Douris*	***Facilitators:** Lynn Maximuk* ***Rapporteurs:** Alexandre Vacher, Sahar Safaei, Alfredo Capello, Philmore Mullen* ***Secretariat Support staff:** Samuel Muchemi, Jean-Noel Degrace*

➢ Day 3 – Thursday 4 November 2010

Session 4: Risk Analysis, Data Management and Exchange Issues to support DRM and EWS with Multi-Hazard Approach (continued)

Chair: Mr. Niels Holms-Nilesen, The World Bank

0900 - 1030 **Room: Khairoon**	• Statement from Curacao on the impacts on Tomas – Alfredo Capello, Erno Maximo Candelaria, Ms. Pedzi V.J. Girigorio • **Session 4: Plenary Discussions on the outcomes of the Working** ➢ *Presentation by Rapporteur of Working Group A (20 Mins)* ➢ *Presentation by Rapporteur of Working Group B (20 mins)* ➢ *Presentation by Rapporteur of Working Group C (20 mins)* ➢ *Final discussions on the recommendations from session 4*
1030 - 1100	**Coffee break**

Session 5: Monitoring, Forecasting and Watch and Warning Systems (National and regional perspectives)

This session involves a panel presentation/discussion on coordination of real-time observation networks and monitoring as critical input for forecasting systems, and coordination and strengthening of forecasting capacities. Furthermore, this session will address challenges and opportunities for coordination of watch and warning systems in the region. Following the panel, the participants will be divided into three working groups to discuss and analyze their specific capacities, gaps and needs in the national and regional contexts and identify priorities for strengthening these areas to be addressed in the Caribbean MHEWS regional programme. Also the working groups will provide concrete recommendations for high priority activities, to be included in phase-I project building on relevant existing projects and activities in the region. A list of the participants in each working group will be shared at the Workshop.

Chair: Dr. David Farrell, CIMH

1100 – 13:00 **Room: Khairoon**	• **<u>Panel 4: Issues, challenges and opportunities for harmonization, exchange and real time coordination of hydro-meteorological observation networks, forecasting expertise and watch and warning systems</u>** ➢ *Presentation of the common gaps, needs and priorities that have been identified from the assessments and interviews with the participating countries, islands and regional agencies - (Dr. Maryam Golnaraghi (WMO) and Jean-Noel Degrace (WMO Consultants) (5 mins)* ➢ *Hydro-Meteorology and Sustainable Development in the Caribbean (Dr. David Farrell – CIMH) (20 mins)* ➢ *Hydro-meteorological Forecasting and Opportunities for Climate Analysis (Mr. Shawn Boyce - CIMH) (15 mins)*

	➢ *Progress and development with monitoring and forecasting of tsunamis in the Caribbean region (Dr. Lorna Inniss and Ms. Diana Patricia MOSQUERA - ICG Tsunami – Caribbe and UNESCO-IOC) (20 mins)* ➢ *Opportunities for strengthening of regional cooperation in forecasting for Hydro-meteorological hazards (e.g., Sever weather, FFG, marine and coastal related hazards) and related training – (Mr. Peter Chen and Edgard Cabrera, WMO) (25 mins) – Via Video* ➢ *Challenges and opportunities for coordination of Watch and Warning Systems in the Caribbean –* - *WMO RSMC Miami - Hurricane Centre (Lynn Maximuk, NOAA-NWS) (15 mins)* - *Contribution of the Hurricane Committee (Dr. Jose Rubiera, RA IV Rep of Hurricane Committee) (15 mins)* ➢ *Reflections on the outcomes and relevance of various regional observation programmes and projects to support EWS (5 mins statements):* - *RAIV WIGOS Task Team (Mr. Glendell De Souza, CMO)* - *Carib Radar Network (Mr. Glendell De Souza, CMO)*
1300 - 1430	**Lunch**

Session 5: Working Groups

Topic 1: Forecasting capacities and expertise and related telecommunication issues (National and Regional aspects)

1430 - 1600	**Working Group A** ***Facilitators**: Jennifer Milton* ***Rapporteurs**: Glendell De Souza, Omar Afflick,* ***Secretariat Support staff**: Charles Baubion, Oscar Arango*	**Working Group B** ***Facilitators:** Sergio Pasquini* ***Rapporteurs:** Sonia Nurse, Danielle Evanson,* ***Secretariat Support staff:** James Douris*	**Working Group C** ***Facilitators:** Lynn Maximuk* ***Rapporteurs:** Alexandre Vacher, Sahar Safaei, Alfredo Capello, Philmore Mullen* ***Secretariat Support staff:** Samuel Muchemi, Jean-Noel Degrace*
1600 - 1630	**Coffee break**		

Topic 2: Observing networks and monitoring and related telecommunication issues (National and Regional Aspects)

1630 – 1800	**Working Group A** ***Facilitators**: Jennifer Milton* ***Rapporteurs**: Glendell De Souza, Omar Afflick,* ***Secretariat Support staff**: Charles Baubion, Oscar Arango*	**Working Group B** ***Facilitators:** Sergio Pasquini* ***Rapporteurs:** Sonia Nurse, Danielle Evanson,* ***Secretariat Support staff:** James Douris*	**Working Group C** ***Facilitators:** Lynn Maximuk* ***Rapporteurs:** Alexandre Vacher, Sahar Safaei, Alfredo Capello, Philmore Mullen* ***Secretariat Support staff:** Samuel Muchemi, Jean-Noel Degrace*

➢ Day 4 – Friday 5 November 2010

Topic 3: Coordination of multi-hazard watch and warning systems (National and Regional Aspects)

0900 – 1030	**Working Group A** ***Facilitators**: Jennifer Milton* ***Rapporteurs**: Glendell De Souza, Omar Afflick,* ***Secretariat Support staff**: Charles Baubion, Oscar Arango*	**Working Group B** ***Facilitators:** Sergio Pasquini* ***Rapporteurs:** Sonia Nurse, Danielle Evanson,* ***Secretariat Support staff:** James Douris*	**Working Group C** ***Facilitators:** Lynn Maximuk* ***Rapporteurs:** Alexandre Vacher, Sahar Safaei, Alfredo Capello, Philmore Mullen* ***Secretariat Support staff:** Samuel Muchemi, Jean-Noel Degrace*
1030 - 1100	**Coffee break**		

Session 5: Monitoring, Forecasting and Watch and Warning Systems (National and regional perspectives) (Continued) ***Chair: Dr. Maryam Golnaraghi, WMO***	
1100 - 1300 **Room: Khairoon**	• **Plenary Discussions on the outcomes of the Working Groups for Topics 1, 2 and 3 in Session 5** ➢ *Presentation by Rapporteur of Working Group A (20 Mins)* ➢ *Presentation by Rapporteur of Working Group B (20 mins)* ➢ *Presentation by Rapporteur of Working Group C (20 mins)* ➢ *Final discussions on the recommendations from session 5*
1300 - 1400	**Lunch**
Session 6: Final Synthesis and Recommendations **Room: Khairoon** ***Facilitator: Dr. Maryam Golnaraghi, WMO***	
1400 -1530	• Review and discussion of the overall outcomes and Recommendations for the development of the Caribbean Regional MHEWS Programme and the priorities for Phase-I project development
1530 – 1545	Coffee Break
1545 - 1700	• Reflection of International and Regional Funding and Development Agencies on the areas they support in the Multi-Hazards Early Warning System (MHEWS) Programme, the outcome of the Workshop and the next steps ➢ *IADB, CDB, EU, DFID, Finnish Ministry of Foreign Affairs, JICA, CIDA, UNDP, World bank, USAID/OFDA, Others (TBD)*
1700 - 1730	• Wrap up Session and Next Steps ➢ *Ms. Michelle Gyles McDonnough, United Nations RC/UNDP RR (10 mins)* ➢ *Dr. Maryam Golnaraghi, WMO (10 mins)*
17:30 - 1740	• Official Closing of the event ➢ *Mr. Hampden Lovell, Director, Meteorological Services of Barbados, Permanent Representative of Barbados with WMO*

Composition of Working Groups A, B, C

The Barbados MHEWS Workshop participants were separated into three working groups based on the type of NMS and relationships and is listed by country/territory or agency as indicated below.

WORKING GROUP A NMS I , Type I relationships	WORKING GROUP B NMS I + II, Type I relationships	WORKING GROUP C NMS I + III, type I + 2 relationships
BELIZE	BARBADOS	ANGUILLA
CAYMAN ISLANDS	DOMINICA	ANTIGUA and BARBUDA
CUBA	GRENADA	BAHAMAS
DOMINICAN REPUBLIC	ST-VINCENT and the GRENADINES.	BONAIRE
JAMAICA	TRINIDAD and TOBAGO	BRITISH VIRGIN ISLANDS
SAINT-LUCIA		CURACAO
SURINAME		FRENCH WEST INDIES
		MONTSERRAT
		ST-EUSTATIUS
		TURKS and CAICOS
Agencies		
UNICEF	CARIB-HYCOS	FMI
CMO	CCRIF	UNDP
World Bank	CIMH	
	JICA	
	USA COMET	

Annex IV:

QUESTIONNAIRE FOR THE WORKING GROUPS

Please list the contact information for individuals who contributed to this questionnaire:

Title	First name	Last name	Country	Name of agency	Phone number	e-mail address

Session 3 Working Group Discussions.

Operational Cooperation of the National Meteorological and Hydrological Services (NMHS) and Disaster Risk Management (DRM) Agencies and Service Delivery for MHEWS (National and Regional perspectives)

1.1 Please list the primary agencies engaged in early warning Systems in your country/territories, particularly linked to Early warning Systems for Hydro-Meteorological Hazards (please also include droughts and Tsunamis. What are the roles and responsibilities, and are these documented officially?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

1.2 In reference to section 4.1 (Doc 4) please specify the type of National Meteorological Service (NMS) in your country/territory and define what types of relationships exist with DRM agency in your country /territory?

1.3 Within the context of relationship between the NMS and DRM agencie, have you established Quality Management Systems (QMS) and Standard Operating Procedures (SOP) across the NMS and DRM agency and stakeholders? Are these SOPs available in form of formal common documents? Is your country/territory developing QMS systems for aeronautical applications?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

1.4 Please specify the dissemination mechanism(s) for delivery of warning s to the authorities and public? Who is involved in this dissemination mechanism(s).

1.5 Do you utilize Common Alert Protocol (CAP) for dissemination of your warnings? If not, do you plan to implement CAP and in what timeframe? Annex 1 at the end of this questionnaire

was distributed through the WMO public Weather P to all the NMSs in the Caribbean we would appreciate if you could fill-in this questionnaire.

1.6 How do you assess the effectiveness of the dissemination mechanism(s) to ensure that warnings reach their target audiences in a timely manner? How often per year do you do these assessments?

Please specify if you need capacity development support in these areas and provide details:

Answer:

1.7 Is there a process in your country/territory to identify the needs and requirements of DRM agencies for products and services of NMS? What hydro-meteorological products and services (e.g. observation data, forecasts and warning products) and required by these EWS stakeholders?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

1.8 Please identify and describe the evaluation and feedback mechanisms within the operational early warning system in your country/territory. Has there been a significant re-evaluation and improvement of your EWS in the past? If yes, please indicate what lead to this re-evaluation and describe the improvements made.

If this is an area, you need capacity development support, please specify and provide details.

Answer:

1.9 Please reflect on your top 5 priorities for national development the above mentioned areas? Also reflect on your priorities for strengthening of existing regional cooperation mechanisms and regional institutional capacities in support of the above-mentioned issues in this section..

Answer:

Session 4 Working Group Discussions.

Risk Analysis, Data Management and Exchange Issues to support DRM and EWS with Multi-Hazard Approach (National and Regional perspectives)

2.1 What is your assessment of hazard data collection procedures, quality, availability, maintenance and sharing within your respective institution/sector, and across sectors in your

country? Are you in need for Data rescue Is there a dedicated process to collect and map data and information for vulnerability assessment to hydrometeorological and marine hazards? If yes, what are the institutions involved and how do they collaborate? Do you collect hazard losses and impact date, and standardization?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

2.2 What is the experience in hazard data analysis and hazard mapping within your respective institution / country?

If this is an area, you need capacity development support, please specify and provide details.

Answer:

2.3 Have you been utilizing any risk assessment or modelling that combines hazard analysis and vulnerability assessment in your operations? If not, do you see any application of such assessments in your operations?

If this is an area, you need capacity development support, please specify and provide details.

Answer:

2.4 In your view, what would be the added-value of a regional process for risk assessment in the Caribbean? Which areas should cover such a regional process? What are the current regional capacities in Hazard/risk analysis?

2.5 Please provide specific recommendations on challenges and needs for strengthening regional institutions and their capacities in supporting hazard/risk analysis for Hydro-met related hazard?

Answer:

2.6 Please reflect on your top 5 priorities for national development the above mentioned areas? Reflect on your priorities for strengthening of existing regional cooperation mechanisms and regional institutional capacities in support of the above-mentioned issues in this secion

Answer:

Session 5 Working Group Discussions.
Monitoring, Forecasting and Watch and Warning Systems (National and Regional perspectives)

Forecasting capacities and expertise and related telecommunication issues (National and Regional aspects)

3.1.1 What are the sources of data, products and information that you are using for developing forecasts and warnings (e.g. internet, GTS, Regional institutions, etc) in your country/territory? What models, data and information do you utilise from these sources to develop your forecasts and warnings?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.2 Are your forecasters regularly trained in methodologies and forecasting techniques? Please specify here what training programme are utilised. Are these training programmes sufficient? If not, what areas need improvement (e.g. interpretation of numerical weather prediction products, basic meteorology, tropical meteorology, hydrology, climatology, modelling, etc)?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.3 Is there coordination among the technical agencies (e.g. Meteorological service, Hydrological service, Marine and Coastal Service, etc.) (real-time or not) to develop forecasts and warning products in your country/territory? If yes, please specify which agencies are involved in this coordination and how is it done?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.4 What regional centres do you utilise for developing your forecast and warnings (e.g. CMO/CIMH, RSMC-Miami Hurricane Centre, etc.)? What products do you utilise from these centres? Could this regional cooperation be improved and strengthened, and in what areas?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.5 What kind of telecommunication network do you utilise for exchanging forecasts and warnings data information and products at the national, regional and international levels? Are these capacities sufficient and reliable? If not, how should these capacities be improved or strengthened?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.6 Please reflect on your top 5 priorities for national development the above mentioned areas? Reflect on your priorities for strengthening of existing regional cooperation mechanisms and regional institutional capacities in support of the above-mentioned issues in this section.

Answer:

Observing networks and monitoring and related telecommunication issues (National and Regional Aspects)

3.2.1 Does your meteorological service operate an observation network? Please describe this network specifying its spatial coverage and whether it is real or not real-time.

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.2.2 Are there any other agencies that are operating other meteorological, hydrological and other relevant observation network in your country/territory? If yes please specify what agency, the kind of observation network it is, and if there is a coordination mechanism for data exchange (please describe).

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.2.3 Do you exchange and/or receive observations with regional centres and/or other neighbouring countries/territories? Please specify what kind of data and through what mechanisms. How could these mechanisms be improved?

If this is an area, you need capacity development support, please specify and provide details:

Answer:

3.1.7	**Please reflect on your top 5 priorities for national development the above mentioned areas? Reflect on your priorities for strengthening of existing regional cooperation mechanisms and regional institutional capacities in support of the above-mentioned issues in this section.**
	Answer:

Coordination of multi-hazard watch and warning systems (National and Regional Aspects)

3.3.1	**Please specify the institutions in your country/territory have the mandate to issue watch and warnings and for what hazards?** **If this is an area, you need capacity development support, please specify and provide details:**
	Answer:
3.3.2	**Is there a coordination mechanism among EWS stakeholders particularly between the NMHS and DRM agency for watch and warning issuance? Please describe this mechanism specifying whether this is a formal (through Standard Operational Procedures or MoUs) or informal mechanism.** **If this is an area, you need capacity development support, please specify and provide details:**
	Answer:
3.3.3	**Does your country/territory coordinate with regional centres or institutions for issuance of watch and warnings? If yes please describe this mechanism, specifying whether this is a formal (through Standard Operational Procedures or MoUs) or informal mechanism.** **If this is an area, you need capacity development support, please specify and provide details:**
	Answer:
3.1.8	**Please reflect on your top 5 priorities for national development the above mentioned areas? Reflect on your priorities for strengthening of existing regional cooperation mechanisms and regional institutional capacities in support of the above issues for Watch and Warning systems.**
	Answer:

Annex 1: WMO Register of Alerting Authorities and CAP

Background: The Register of Alerting Authorities is maintained by WMO to publicize the sources of alerts regarded by WMO Members as authoritative. This information can serve many purposes, such as news reporting, emergency management, and inter-governmental coordination.

For each WMO Member country, the Register of Alerting Authorities contains one or more alerting authority records. Each alerting authority record shows the types of hazards for which the alerting authority issues alerts, the geographic scope for which the alerting authority issues alerts, and (if available) an Internet URL where current alerts from the alerting authority may be found.

The content of the Register of Alerting Authorities is maintained by WMO Member editors, each of which has been officially designated by the respective Permanent Representative with WMO. The Register can be accessed at http://www.wmo.int/alertingorg.

Participants in this Meeting are asked to provide, in the boxes below, preliminary information that should be in the Register of Alerting Authorities. All preliminary information will be verified with officially designated editors before being published in the Register. Fill out one box per alerting authority and use additional sheets to report more than seven authorities in a country.

Country: _____

Form information provided by (your name and e-mail):_____

Editor designated by PR with WMO (e-mail, if known): _____

Alerting Authority (1): _____

Examples: National Meteorological Service, National Hydrological Service

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire ☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Check all that apply for this alerting authority (see category descriptions below)

Area of alerting: _____

Examples: National boundaries, Multiple nations (specified), Caribbean-wide

URL (if known): _____

Example: http://www.worldweather.org/041/c00151.htm

Alerting Authority (2): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire ☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Hazard Categories

Geo: Geophysical (earthquakes, volcanoes, etc., includes landslide)
Met: Meteorological (weather, storms, etc. includes flood)
Safety: General emergency and public safety
Security: Law enforcement, military, homeland and local/private security
Rescue: Rescue and recovery
Fire: Fire suppression and rescue
Health: Medical and public health
Env: Pollution and other environmental
Transport: Public and private transportation
Infra: Utility, telecommunication, other non-transport infrastructure
CBRNE: Chemical, Biological, Radiological, Nuclear or High-Yield Explosive threat or attack
Other: Other events

Alerting Authority (3): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire
☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Alerting Authority (4): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire
☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Alerting Authority (5): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire
☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Alerting Authority (6): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire
☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Alerting Authority (7): _____

Hazard Categories: ☐ Geo ☐ Met ☐ Safety ☐ Security ☐ Rescue ☐ Fire
☐ Health ☐ Env ☐ Transport ☐ Infra ☐ CBRNE ☐ Other

Area of alerting: _____

URL (if known): _____

Annex V

Terms of references of the RA IV Hurricane Committee[5]

(a) To coordinate tropical cyclone forecast and warning operational procedures as a means of minimizing tropical cyclone damage;

(b) To coordinate, in carrying out its functions, with the RA IV Management Group;

(c) To serve as a forum for exchange of information on new developments in the science and technology of tropical cyclone observation, tracking and forecasting;

(d) To make recommendations on improvements in facilities and procedures as needed to ensure efficient and effective early warning systems against tropical cyclones and associated phenomena;

(e) To advise the Association on the possible sources of technical and financial support and, where deemed necessary, to initiate positive action in this regard for the development and strengthening of such warning systems and their infrastructures;

(f) To engage, in carrying out its function, the appropriate experts in the areas of Integrated Observing System and WMO Information System (WIS); Hydrology; and Disaster Risk Reduction and Service Delivery; as well as other experts or institutions as appropriate;

(g) To serve as a forum for tropical cyclone disaster prevention and preparedness activities appropriate to meteorological and hydrological services;

(h) To provide appropriate community information, education and training, and awareness efforts on meteorological and hydrological effects of tropical cyclones;

(i) To encourage governments to adopt measures to mitigate the potential harmful impacts of tropical cyclones;

(j) To foster cooperative efforts of WMO and other international bodies in those aspects of tropical cyclone disaster preparedness and prevention that can benefit from meteorological and hydrological assistance;

(k) To promote greater emphasis on training activities through the provision of appropriate facilities and financial support as necessary;

(l) To serve as a forum to share with RA IV experts on Disaster Risk Reduction and Service Delivery and other experts or institutions as appropriate: (i) best practices on hurricane forecast and warning operational procedures, (ii) recommendations on improvements in facilities and procedures in order to ensure efficient and effective warning systems, as well as (iii) tropical cyclone disaster prevention and preparedness activities appropriate to meteorological and hydrological services;

(m) To ensure the deliberations and planning of the Hurricane Committee bear significant relevance to the regional efforts on disaster risk reduction – service delivery, hydrology and the WMO Integrated Observing System and WMO Information System and others as necessary in consultation with the RA IV Management Group;

[5] WMO-No. 1041: Regional Association IV (North America, Central America and the Caribbean), Fifteenth session, Nassau, 24 April–1 May, 2009 (pp 77)

Annex VI

Roles and responsibilities of Technical and Political Regional Bodies

World Meteorological Organization (WMO) - Region IV

i. All the countries islands (except three of them - Grenada, St-Kitts & Nevis, St-Vincent and the Grenadines) are part of the regional association IV of WMO.

ii. The RAIV established its Hurricane Committee (1978) as the regional component of the WMO tropical cyclone programme with the terms of reference listed in Annex VIII.

iii. This Regional Body works under the Hurricane Operational Plan (HOP) with a view to ensuring the most effective co-operation and co-ordination between the countries in preparing and issuing meteorological forecasts and warnings of all tropical cyclones affecting the area. The plan records the agreements reached on the sharing of responsibilities for the warning services, and their infrastructures, throughout its region and defines the observing, forecasting and warning responsibilities of all cooperating Members and deals with other related items such as terminology and communications. It serves as a valuable information source for the operational services and focuses on (i) Responsibilities of members, (ii) Tropical cycole products of RSMC Miami, (iii) Surface and upper air observation, (iv) Radar and satellite information and products, (v) aircraft reconnaissance, and (vi) communication.

iv. The RA IV Hurricane Committee also has a Technical Plan and its Implementation Programme that sets out the coordinated steps to be taken by Members for future development to meet regional needs for upgrading forecasts and warning services for hurricanes and associated floods as well as for related disaster prevention and preparedness measures and supporting activities in training and research. The Technical Plan has several components that comprise (i) the meteorological component for observing, monitoring, forecasting and warning, (ii) the hydrological component for hydrological forecasting, studies, maps, services and facilities, (iii) the disaster reduction and preparedness component, (iv) the training component and (v) the research component

v. The two plans are updated yearly to incorporate new facilities, advances and developments during the meeting of the RAIV-HC

Regional Specialized Meteorological Centre (RSMC) Miami (NOAA National Hurricane Center)

vi. The RSMC Miami is responsible for the distribution of information, advisories, and warnings regarding the tropical cyclones in the North Atlantic and Eastern North Pacific oceans, agreed by consensus at the World Meteorological Organization.

vii. RSMC Miami provides forecasts and guidance on watches and warnings to 30 WMO Member nations and issues marine forecasts and graphical products for portions of the Atlantic and the Eastern Pacific. RSMC has put in place coordination mechanisms with all the members in case of tropical cyclone threat and possible impact.

viii. It also hosts and teaches a two-week workshop on tropical cyclones for international government meteorologists.

ix. NHC Director serves as Chair of the WMO RA-IV Hurricane Committee

x. For more information on RSMC Miami, please refer to “The Regional Association IV (North America, Central America and the Caribbean) Hurricane Operational Plan” (WMO-TD No. 494) which lays out the responsibilities of Members and the tropical cyclone products of the RSMC Miami amongst other topics such as ground radar observations, satellite surveillance, aircraft reconnaissance, surface and upper air observations and communications.

Caribbean Meteorological Organization (CMO) and its Caribbean Institute for Meteorology and Hydrology (CIMH)

(See CMO web site http://www.cmo.org.tt/About.htm and http://www.cmo.org.tt/About.htm for more information)

xi. The Caribbean Meteorological Organization is a specialized agency of the Caribbean Community that coordinates the joint scientific and technical activities in weather-, climate- and water-related sciences in sixteen English-speaking Caribbean countries. The supreme body of the Organization, The Caribbean Meteorological Council meets once per year to define policy for the Organization.

xii. As weather and climate know no national boundaries, cooperation at a regional and international scale is essential for the development of meteorology and operational hydrology as well as to reap the benefits from their applications. CMO provides the framework for such regional and international cooperation.

xiii. The CIMH is the education, training, and research arm of the CMO. The role and mission of the CIMH is to improve the meteorological and hydrological services and to assist in promoting the awareness of the benefits of these services for the economic well-being of the CMO countries. This is achieved through training, research and investigations, and the provision of specialised services and advice.

xiv. The Institute is located at Husbands, in the parish of St. James, Barbados, on the western side of the island. This location is about two kilometres from the Cave Hill Campus of the University of the West Indies, with which the Institute is affiliated. The Institute was designated as a Regional Meteorological Training Centre by the World Meteorological Organisation (WMO) in 1978 in recognition of the high standard of its training programmes. Students from all parts of the Caribbean, and sometimes beyond, are trained in such branches of meteorology as weather observing, forecasting, radar and satellite meteorology, instrument maintenance, agrometeorology, and climatology, and in operational hydrology.

xv. The primary functions of the Institute are to:

(i) Provide facilities for the training of various categories of meteorological and hydrological personnel

(ii) Operate as a centre of research in meteorology and hydrology and associated sciences

(iii) Operate as contractors and consultants on various meteorological and hydrological projects

(iv) Maintain a service for the upkeep, repair, and calibration of meteorological instruments

(v) Provide advice to participating governments on meteorological and hydrological matters

(vi) Collect, analyze, and publish meteorological and hydrological data

xvi. Members are: Antigua and Barbuda, Barbados, BCTs (Anguilla, B.V.I, Cayman Islands, Montserrat, Turks & Caicos), Belize, Dominica, Grenada, Guyana, Jamaica, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines and Trinidad and Tobago.

xvii. The CMO Member States with Weather Forecast and Warning Offices are Antigua and Barbuda, Barbados, Belize, Cayman Islands, Grenada, Guyana, Jamaica, Saint Lucia, and Trinidad and Tobago. The Member States with Aeronautical Meteorological Offices are Anguilla, British Virgin Islands, Dominica, Montserrat, St. Kitts/Nevis, St. Vincent and the Grenadines, and the Turks and Caicos Islands.

The Caribbean Community Climate Change Centre (CCCCC)

(from CCCCC web site, more information on http://www.caribbeanclimate.bz)

xviii. The CCCCC (often called 5Cs), located in Belmopan (Belize), coordinates the Caribbean region's response to climate change for the CARICOM countries. Officially opened in August

2005, the Centre is the key node for information on climate change issues and on the region's response to managing and adapting to climate change in the Caribbean.

xix. Through its role as a Centre of Excellence, the Centre is supporting the Caribbean to address the impact of climate variability, through the provision of timely forecasts and analyses of potentially hazardous impacts of both natural and man-induced climatic changes on the environment, as well as for the development of special programmes with create opportunities for sustainable development.

Caribbean Disaster Emergency Management Agency (CDEMA)

(from CDEMA web site, more information on http://www.cdema.org/index.php?option=com_content&view=article&id=358&Itemid=120)

xx. CDEMA has refocused its attention on Comprehensive Disaster Management (CDM) which is a new thrust in disaster management for the 21st Century. It focuses on all cycles of a hazard, involving all sectors of the society, and concentrating on all hazards. This strategy has been endorsed by all member states and accepted by the Association of Caribbean States (ACS) which will see it being promoted in the Latin American states of the ACS. At the crux of CDM is a well informed and aware public and activities to achieve full compliance with CDM are at the heart of the CDEMA operation. This operation includes:

(i) Training for Disaster Management Personnel;
(ii) Development of model training courses and products;
(iii) Institutional Strengthening for Disaster Management Organizations;
(iv) Development of model Disaster Legislation for adaptation and adoption by Participating States;
(v) Development of model policies and guidelines for use in emergencies;
(vi) Contingency Planning;
(vii) Resource mobilization for strengthening disaster management programmes in Participating States;
(viii) Improving Emergency Telecommunications and Warning Systems;
(ix) Development of Disaster Information and Communication Systems;
(x) Education and Public Awareness;

xxi. Members are: Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, BVI, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago and Turks & Caicos.

Annex VII

1. Regional CMO Arrangements for Meteorological Forecast and Warning Services to Other States

2.

3. Background

The **Caribbean Meteorological Council,** which is the Governing body of the Caribbean Meteorological Organization (CMO) met for its 50th session in the Cayman Islands on 22-23 November 2010. The Council held an extensive discussion on the responsibilities of National Meteorological and Hydrometeorological Services (NMHS) of the CMO Member States. It recalled how the NMHSs developed to various scientific and technical levels over the years. When the CMO was established in 1973 to replace the Caribbean Meteorological Service (CMS) after the breakup of the West Indies Federation, there were several National Meteorological Services operating observing stations and a few Forecast and Warning Offices. In the process, the Council set in place a set of forecast and warning responsibilities, in which the larger NMHSs provide weather forecast and warning services for neighbouring smaller Services. These arrangements have been modified by the Caribbean Meteorological Council over the years.

The CMO Member States with ***Weather Forecast and Warning Offices*** are Antigua and Barbuda, Barbados, Belize, Cayman Islands, Grenada, Guyana, Jamaica, Saint Lucia, and Trinidad and Tobago. The Member States with ***Aeronautical Meteorological Offices*** are Anguilla, British Virgin Islands, Dominica, Montserrat, St. Kitts/Nevis, St. Vincent and the Grenadines, and the Turks and Caicos Islands.

Today, the forecast and warning responsibilities of CMO Member States have evolved to the following:

Member States with Weather Forecast and Warning Offices	**States and Areas of Responsibility for Forecasts and Warnings**
Antigua & Barbuda	The islands and coastal waters of Antigua & Barbuda, Anguilla, British Virgin Islands, Montserrat, St. Kitts & Nevis
Barbados	The islands and coastal waters of Barbados, Dominica, St. Vincent and the Grenadines
Belize	The islands, coastal waters and inland areas of Belize
Cayman Islands	The islands and coastal waters of the Cayman Islands
Grenada	The islands and coastal waters of Grenada and its dependencies (weather forecasts)
Guyana	The coastal waters and inland areas of Guyana
Jamaica	The island and coastal waters of Jamaica
Saint Lucia	The island and coastal waters of Saint Lucia
Trinidad and Tobago	The islands and coastal waters of Trinidad and Tobago; tropical cyclone warnings responsibility for Grenada and its dependencies

By agreement between CMO and The Bahamas (non-CMO Member), the Bahamas area of responsibility for forecasts and warnings includes the islands and coastal waters of the Turks and Caicos Islands

These arrangements form the basis for many other international arrangements or agreements, such as the Caribbean-wide Early Warning System for tropical storms, hurricanes and other severe weather under the auspices of the *World Meteorological Organization* (WMO), as well as the basis for the provision of aeronautical meteorological forecasts and warnings under the auspices of the *International Civil Aviation Organization* (ICAO).

In recent years, questions have arisen in some quarters about the formalities involved in the process, since there is no single document that puts all these agreements together. To rectify this situation, Council reviewed the system and adopted the attached **Resolution 2 of CMC50.**

CARIBBEAN METEOROLOGICAL ORGANIZATION

RESOLUTION OF THE CARIBBEAN METEOROLOGICAL COUNCIL – THE MINISTERIAL GOVERNING BODY OF THE CMO

4. RESOLUTION 2 - 50th Session, Cayman Islands, 22-23 November 2010

5.

6.

7. REGIONAL ARRANGEMENTS FOR METEOROLOGICAL FORECAST AND WARNING SERVICES AMONG CMO MEMBER STATES

THE CARIBBEAN METEOROLOGICAL COUNCIL,

Noting that the National Meteorological and Hydrometeorological Services (NMHS) of the CMO Member States have developed to various scientific and technical levels over the years,

Considering that the ***Weather Forecast and Warning Offices*** of Member States, with the higher scientific and technical levels and functions, operate round-the-clock and year-round and that the ***Aeronautical Meteorological Offices*** of Member States operate according to aeronautical requirements,

Taking into account the existing arrangements made under the auspices of the Caribbean Meteorological Organization in which the Member States with the Weather Forecast and Warning Offices provide the same weather forecast and warning services to those States without such offices, as well as the back-up arrangements between Services,

Noting further that these arrangements form the basis for many other international arrangements or agreements, such as responsibilities of Member States for forecasts and warnings within the Regional Hurricane Warning System of the *World Meteorological Organization* (WMO) and the provision of aeronautical meteorological forecasts and warnings under the auspices of the *International Civil Aviation Organization* (ICAO),

Recognizing the major importance of these arrangements and **having reviewed** the scientific and technical capacities of the NMHSs of Member States,

Decides that the following arrangements shall apply:

Member States with Weather Forecast and Warning Offices	**States and Areas of Responsibility for Forecasts and Warnings**
Antigua & Barbuda	The islands and coastal waters of Antigua & Barbuda, Anguilla, British Virgin Islands, Montserrat, St. Kitts & Nevis
Barbados	The islands and coastal waters of Barbados, Dominica, St. Vincent and the Grenadines

The CMO comprises the following sixteen (16) Member States: *Anguilla, Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands*

Belize	The islands, coastal waters and inland areas of Belize
Cayman Islands	The islands and coastal waters of the Cayman Islands
Grenada	The islands and coastal waters of Grenada and its dependencies (weather forecasts)
Guyana	The coastal waters and inland areas of Guyana
Jamaica	The island and coastal waters of Jamaica
Saint Lucia	The island and coastal waters of Saint Lucia
Trinidad and Tobago	The islands and coastal waters of Trinidad and Tobago; tropical cyclone warnings responsibility for Grenada and its dependencies
By agreement between CMO and The Bahamas (non-CMO Member), the Bahamas area of responsibility for forecasts and warnings includes the islands and coastal waters of the Turks and Caicos Islands	

Also decides that the following backup arrangements for tropical cyclone watches and warnings, Aerodrome Forecasts (TAF) for main airports and agreed upon essential products, as determined under the auspices of the WMO and ICAO, shall apply:

(a) Antigua will take over the responsibility of Barbados with respect to the island and coastal waters of Dominica;

(b) Barbados will take over the responsibility of Antigua and/or Saint Lucia;

(b) Barbados will take over the responsibility of Trinidad and Tobago;

(c) Jamaica will take over the responsibility of the Cayman Islands;

(d) Trinidad and Tobago will take over the responsibility of Barbados with respect to the islands and coastal waters of Barbados and St. Vincent and the Grenadines;

(e) The USA will take over the responsibility of Jamaica.

Further decides

(i) that the NMHSs of all Member States should ensure that all stakeholders at the national level are aware of these arrangements and that the CMO Headquarters should make this Resolution permanently available on its Website;

(ii) that variations in the international arrangements or agreements emanating from the above should be made in collaboration with and coordinated by the Headquarters of the Caribbean Meteorological Organization,

(iii) to review this Resolution whenever significant changes in the arrangements are proposed.

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