CARIBBEAN DEVELOPMENT BANK

TECHNICAL ASSISTANCE- EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN - REGIONAL

Considered at the Two Hundred and Seventy-Seventh Meeting of the Board of Directors on July 20, 2017

Coordinator, Environmental Sustainability Unit, (ESU)	Cheryl Dixon
Project Manager, ACP-EU-CDB NDRM, ESU	Dr. Yves Robert Personna

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TWO HUNDRED AND SEVENTY-SEVENTH MEETING OF THE BOARD OF DIRECTORS

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TECHNICAL ASSISTANCE- EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN - REGIONAL

1. BACKGROUND

1.01 The Inter-governmental Panel on Climate Change (IPCC) has reported scientific evidence of global warming resulting from human activities that contribute to increasing concentrations of greenhouse gases in the atmosphere. An unprecedented rate of warming of the climate system has been observed since 1950 in comparison with previous decades and millennia[1]. In the Northern Hemisphere, the period 1983–2012 was the warmest 30-year period of the last 1400 years. Although Small Island Developing States (SIDS) including those in the Caribbean contribute minimally (less than one percent) to global emissions, they are among the most vulnerable countries to the impacts of climate variability and climate change (CVC).

1.02 CVC has been affecting the region's marine and terrestrial ecosystems' ability to maintain their ecological functions and provide natural resources that are essential for the livelihoods of the people and Caribbean economic development. Among the expected manifestations of climate change (CC) in the Caribbean are sea-level rise and disruption of traditional rainfall patterns. Under an intermediate low-emissions scenario, projections are for the Caribbean region to have an average annual increase in surface temperature of 1.2–2.3°C, a decrease in rainfall of about 5–6 % and a sea level rise of 0.5–0.6 meters by the end of the century. Many borrowing member countries (BMCs) of the Caribbean Development Bank (CDB) have significant low-lying coastlines that could be subject to increased incidences of coastal flooding and coastal erosion by mid-century as a result of CC.

1.03 Climate information will need to be tailored and packaged appropriately to serve the needs of end-users in all climate sensitive sectors. Climate variability and uncertainty is projected as significant consequence of climate change, which could cause significant social displacement and economic losses and even jeopardise the existence of some coastal cities. Without appropriate mitigation and adaptation measures, CVC will have significant impacts on the socio-economic development of the region. Equipping policy-planners and the most vulnerable communities with early climate/weather information and advisories to anticipate climate-related shocks and changes is an urgent priority.

1.04 Regional institutions such as the Caribbean Institute for Meteorology and Hydrology (CIMH), the Caribbean Community Climate Change Centre (CCCCC), and the University of the West Indies (UWI), with the support of the development community, including CDB, have been working collaboratively through various programmes to support capacity development initiatives to enhance weather and climate

[1] IPCC, 2014, The IPCC's Fifth Assessment Report, What's in it for SIDS?

early warning systems (EWS) and impacts-based forecasting in the region, and to develop and deliver operational climate products and services for climate sensitive sectors at season and sub-seasonal timeframes. A consortium of regional sectoral early warning information systems across climate timescales (EWISACTS) has been established in the Caribbean to support the implementation of the global framework for climate services (GFCS), launched at the World Climate Conference in 2009 to strengthen the production, availability, delivery and application of science-based climate monitoring and prediction services. The EWISACTS consortium has adopted an integrated approach for the coordination, design, development and delivery of climate products and services that address targeted stakeholder needs such as Caribbean Public Health Agency (CARPHA), Caribbean Centre for Renewable Energy and Energy Efficiency, Caribbean Tourism Organization, Caribbean Agricultural Research and Development Institute, Caribbean Water and Wastewater Association, Caribbean Disaster and Emergency Management Agency (CDEMA) and CIMH. The regional integrated climate services model is shown at Appendix 1.

1.05 CIMH is the regional training and research organisation focusing on meteorology, climatology, hydrology, and agro-meteorology in the Caribbean. It is a repository for climate data from the Caribbean Meteorological Organisation (CMO) Member States[2]. The role and mission of CIMH is to improve meteorological and hydrological services and to promote awareness of the benefits of these services for the economic well-being of the member countries. CIMH is affiliated with UWI where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology. CIMH is recognised by the World Meteorological Organisation (WMO) as: (i) the WMO regional training centre in the Caribbean for meteorology and hydrology and related disciplines; (ii) a regional instrument centre for the Caribbean; (iii) a centre of excellence in satellite meteorology training; and (iv) the WMO's Regional Climate Centre (RCC) for the Caribbean.

1.06 As part of its work to enhance the Region's resilience to hydro-meteorological and climatic events, CIMH has been using numeric models to develop 48–96 hour weather predictions for the entire Caribbean region since 2006. As the computational resources of CIMH has increased, the spatial resolution of these models has increased to four kilometres (km) resolutions models using the Weather Research and Forecasting (WRF) and Advanced Research WRF Platform providing more accurate forecasts. Improvements in computational efficiency coupled with the decreasing cost of computational platforms are providing a compelling case for National Meteorological and Hydrological Services (NMHSs) in the Caribbean to run their own sub 4km local area numerical weather prediction models. For example, the Belize National Weather Service currently runs a 5 km resolution version of WRF over Belize. Other NMHSs have indicated a desire to follow this trend, and can utilise sub 4 km resolution models outputs from the CIMH model to drive their local area models. To facilitate those NMHSs that support weather forecasting (Antigua and Barbuda, Bahamas, Barbados, Belize, Guyana, Haiti, Jamaica, Saint Lucia and Trinidad and Tobago) with their ambitions to implement their own high-resolution numerical weather prediction platforms, CIMH as the WMO Regional Training Centre for the Caribbean is obligated to provide the training to develop and implement their own numerical weather prediction platform and to integrate the outputs into their forecasts.

1.07 Notwithstanding the advance in high resolution weather prediction models, operational marine forecasting capabilities in the Caribbean have been very limited. This lack of capability is a growing concern given that (a) most BMCs are highly vulnerable to sea level rise and storm surge, (b) the marine economic zone represents by far the largest portion of territory owned by many BMCs, and (c) a large percentage of the livelihoods and economic wealth of these states is associated with the marine environment.

1.08 Another emergent problem is the lack of operational climate-health early-warning systems in the

[2] CMO Member States include all BMCs except Bahamas, Haiti and Suriname.

Caribbean region. Climate variability is a significant environmental driver of vector-borne diseases such as Yellow Fever, Dengue Fever, Chikungunya and Zika which, at various times, have placed significant burdens on national health care and productivity systems. It is estimated that Dengue Fever costs the Caribbean about USD321 million annually[3]. Yellow Fever, Dengue Fever, Chikungunya and Zika in the Caribbean share a common vector, the *Aedes aegypti* mosquito whose proliferation is climate sensitive. Tropical and sub-tropical climate conditions allow the *Aedes aegypti* mosquito to thrive during warmer, wetter and more humid months and the distribution and abundance of that vector may be affected by even small changes in ambient temperature and precipitation. In the Caribbean, prior research observed a link between past climate trends, increased mosquito incidence and Dengue Fever Risk. For example, Dengue Fever occurrence in the Caribbean is known to follow a seasonal pattern to a large extent, with most cases occurring during the second half of the year when temperatures are warm and precipitation and humidity high (Taylor et al, 2009)[4].

1.09 CIMH is coordinating the Caribbean DEWETRA Platform, (the Platform), which is an online geo-spatial platform that utilises dynamic forecast, real-time and near real-time hydro-meteorological and climate hazard information and integrates it with vulnerability and social-economic information to support exposure mapping and impacts forecasting. The Platform is being used by CDEMA, NMHS and the National Emergency Management Offices (NEMOs) to support their decision-making processes during periods of severe weather. However, substantial investment for institutional capacity building is still required to increase the effectiveness of the Platform. Belize and Guyana have indicated an interest in participating in the Caribbean DEWETRA Platform to support local impacts forecasting as a process to strengthen their early warning system and processes. Currently, data from hydro-meteorological stations in Belize and Guyana are being transferred in near real time to the Caribbean DEWETRA Platform. Weather radar data is currently available in the platform for both countries. St. Kitts and Nevis, which was part of the Enhancing Resilience to Reduce Vulnerability in the Caribbean that funded the implementation and operationalisation of the Caribbean DEWETRA Platform, has only two persons who received training in the operation of Platform. Technical support through training is needed to ensure an effective use of the Platform in those three BMCs.

1.10 The Rapid Analysis and Spatialisation of Risk (RASOR) platform has also been increasingly used to perform multi-hazard risk analysis for the full cycle of disaster management including but not limited to targeted support to critical infrastructure monitoring and climate change impact assessment. RASOR offers a single work environment that generates new risk information across hazards, data types and user communities. A scenario-driven query system allows users to simulate future scenarios based on existing and assumed conditions, to compare with historical scenarios, and to model multi-hazard risk both before and during an event. RASOR enables users to go beyond risk identification and compute risk analyses and economic impacts regarding different hazard scenarios. The RASOR platform was successfully used in October 2016 to support modeling of the impact of Hurricane Matthew on the southern peninsula of Haiti. It will be useful to test its applicability to other regions of Haiti. CIMH's access to data for Barbados provides also an opportunity for further testing and exploring the applicability of RASOR in a small eastern Caribbean State. Experience gained from the testing of RASOR in those two countries will guide the further development of the platform, as well as, its rollout across the Caribbean.

1.11 In 2011, CDB provided CIMH with resources to rescue and digitise historical meteorological and hydrological paper datasets, to improve its computing capabilities and to establish an electronic climate database facilitating data storage, access and exchange between the Institute and its member countries. This was a very successful initiative and CDB's investment in CIMH has been sustained and has laid the

[3] Source: https://sta.uwi.edu/uwitoday/archive/april_2013/article6.asp. This estimate does not consider the costs of surveillance, mosquito control and public education programmes or the impact of disruption to the rest of the healthcare system when an outbreak occurs.

[4] Taylor M. A., A. A. C., and W. Bailey, (2009). Review of Health Effects of Climate Variability and Climate Change in the Caribbean (M. A. T. C. C. Project, Trans.) (pp. 85). Belmopan, Belize: Caribbean Community Climate Change Centre (CCCCC).

groundwork for additional improvements to its services. The online regional climate database developed as part of this CDB initiative is currently being upgraded to expand its functionality to serve as a linked national and regional platform. CIMH now generates approximately USD500,000 in annual revenue from training and the sale of data products and data derived products that supplements the annual subventions from contributing member states. This revenue is used to support *inter alia* the management and maintenance of the network and the development and production of new products. As a tertiary regional training institution, capacity development initiatives for CIMH staff cascade to benefit those it trains.

1.12 In an effort to support CIMH's work in the Region, CDB approved in March 2017 a Technical Assistance (TA) grant to CIMH to finance a project that is directed at enhancing weather and climate observation networks within the borrowing member countries (BMCs) of CDB; and strengthening national and regional institutional capacity to monitor and assess weather conditions, and to develop and deliver climate services. CIMH however, still needs more resources to support the on-going initiatives and expand its interventions to fulfil functions in the region. Further, while CIMH's technical capacity is recognised, the Region has limited competent young weather, climate and hydro meteorological professionals to ensure the continuation of the work in the future.

2. PROPOSAL

2.01 It is proposed that CDB provide a grant to CIMH in an amount not exceeding the equivalent of seven hundred and seventy-three thousand and twenty-five euros (EUR773,025) from its Special Funds Resources (SFR), allocated from resources provided under the African Caribbean Pacific-European Union (ACP-EU)-CDB Natural Disaster Risk Management (NDRM) in the CARIFORUM Countries Programme, to build institutional capacity and enhance national and regional resilience to CVC . The resources will be used to fund consulting services and the procurement of goods and services:

(a) build regional capacity to implement WRF Model Platform through adequate training in numerical weather prediction models for 20 participants from CIMH, UWI and eligible NMHS in BMCs with forecasting responsibility;

(b) provide consultancy services to assess CIMH's needs to serve as a marine regional forecasting centre and enhance operational marine forecasting in the Caribbean, including:

  (i) regional training in marine forecasting (five day introductory course and five day intermediate course). Each course will include 25 persons (ten from CIMH, NHMS, NEMOs, CDEMA, UWI in Barbados, and 15 from NHMS in BMCs with forecasting responsibility;

  (ii) five day advanced course in marine forecasting for five persons from CIMH; and

  (iii) five day training in satellite marine forecasting for 20 participants from CIMH, UWI and NMHS in BMCs with forecasting responsibility.

(c) build weather and climate early warning systems for the public health sectors, including:

  (i) development of a modelling framework to provide spatio-temporal probabilistic forecasts of *Aedes aegypti* proliferation;

(ii) demonstration of the approach in Barbados and Dominica[5]; and

(iii) face-to-face training workshop for national and regional experts (ten persons with four drawn from CIMH and the Barbados Ministry of Health and the remainder drawn from CARPHA, PAHO and Dominica) on the modelling framework.

(d) enhance pre and post event monitoring and assessment, including:

(i) training in the use of the Caribbean DEWETRA Platform in Belize, Guyana and St. Kitts and Nevis (15 participants/countries) targeting relevant national and regional organisations from NMHS (5 participants), NEMO (3 participants), and 7 climate sensitive sectors (agriculture, tourism, water, transportation, health) (7 participants); and

(ii) RASOR Consultation/Training at CIMA Foundation: three participants from CIMH, and Pilot Implementation of RASOR on Barbados and Haiti.

(e) train Caribbean professionals in climatology, hydrology, hydrometeorology and related disciplines through short-term and long-term attachments of nine young professionals.

2.02 The Draft Terms of Reference (TOR) for the consultancy services assignment is presented at Appendices 2A to 2E.

3. OUTCOMES

3.01 The expected project outcome is increased predictive capacity of national and regional institutions for weather and climate forecasting. The Design and Monitoring Framework of the proposal is provided at Appendix 3.

4. JUSTIFICATION

4.01 The proposed TA is designed to build institutional capacity and enhance national and regional resilience to CVC. It will enable better management of the risks of CVC and adaptation to CC through the development and incorporation of science-based climate information and prediction into planning, policy and practice at the regional and national scales for specific stakeholder groups. It will provide NMHSs in BMCs with the requisite skills to use the WRF platform to develop high resolution numerical weather prediction models, which will inform planning and decision making processes to reduce the impacts of hydro-meteorological events. Strengthening operational marine forecasting of CIMH will help BMCs to take timely actions to reduce marine hazard risks, and, consequently, improve marine and coastal safety. The development of models to predict climatic conditions favorable to the proliferation, spatial and temporal distribution of the population of mosquito vector, *Aedes aegypti*, is critical for alerting public health systems for adequate responses to reduce the incidences of mosquito-borne viral infection.

4.02. Training of NMHS and NEMO in BMCs on the DEWETRA Platform will result in a greater utilisation of the platform to support impact-forecasting, planning and decision-making related to hydro-meteorological events. This TA will strengthen CIMH's capacity to perform impact analysis through the RASOR Platform. The DEWETRA and RASOR platforms can be used concurrently to deepen hazard risk

[5] Barbados and Dominica have agreed to provide the data required to conduct the studies, and Dominica is recognised as a pilot country for the GFCS.

analyses. This TA will also contribute to developing competent young Caribbean professionals in climatology, hydrology and hydrometeorology and other related disciplines, which is crucial to sustain the on-going work and climate resilience in the Region. An added benefit of the project is that it will facilitate technical exchanges between regional and national partners on issues related to climate risk and resilience.

4.03 Based on the CDB Performance Rating System, the proposed project has been assessed as satisfactory with an overall score of 3.25. A summary of the project performance score is shown in Table 1, and Appendix 5 shows the details of the rating system.

TABLE 1: PROJECT PERFORMANCE SCORE SUMMARY

Criteria	Relevance	Effectiveness	Efficiency	Sustainability	**Overall Score Satisfactory**
Score	4	3	3	3	**3.25**

4.04 Based on CDB Gender Marker, the proposed Project is assessed as gender mainstreamed (GM) with an overall score of 3. The Project will contribute to strengthening institutional capacity and reducing weather and climate related risks in the Caribbean. Thus, it will provide a basis to help women and men to build and protect their assets and improve their quality of life. The gender marker summary is shown in Table 2, and the details are reported at Appendix 6.

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TABLE 2: GENDER MARKER SUMMARY

Gender Marker	**Analysis**	**Design**	**Score**	**Code**
	2	1	3	GM

4.05 The proposed project is consistent with the African Caribbean Pacific-European Union-Caribbean Development Bank (ACP-EU-CDB) Result Areas 2: Improved local, national and regional resilience through strengthened early warning, national risk profiling and community-based DRR and CCA. This project is also consistent with:

(a) CDB Strategic Objectives of supporting inclusive and sustainable growth and development; and

(b) CDB Corporate Priorities of (i) promoting environmental sustainability (climate change resilience, environmental management and DRM); and (ii) strengthening evidence-based policy making.

5. EXECUTION

5.01 The project will be executed by CIMH over a 24-month period. The Work Implementation Schedule is presented at Appendix 7. CIMH will assign, prior to the disbursement of the Grant a Project Coordinator (PC) who will be directly responsible for coordinating the execution of all project activities, ensuring project technical supervision and quality of deliverables. Duties and responsibilities of the PC are presented at Appendix 7. The qualifications and experience of the PC and of any person subsequently assigned to the position of the PC shall be acceptable to CDB. CIMH will report to the ACP-EU-CDB NDRM Project Manager at CDB.

5.02 The Meteorology, Hydrology, and Applied Meteorology and Climatology sections of CIMH will support the PC in reviewing technical documents and ensuring the quality of deliverables. The Administration Section of CIMH will provide support for managing the financial resources, procuring of goods and services, and preparing financial reports.

5.03 CIMH will work collaboratively with national and regional partners in the BMCs including CARPHA, Pan American Health Organisation (PAHO), CDEMA, NEMOs, and NMHSs. These partners will support (a) the development and ultimate implementation of climate-health early warning systems targeting the *Aedes aegypti* vector thereby reducing health impacts of this vector, (b) advancing weather early warning systems across the Caribbean through greater integration of local area numerical weather prediction outputs into national and regional weather and marine forecasts and impacts forecasting platforms, (c) strengthening marine forecasting in the region, and (d) building the next generation of weather and climate professionals in the region.

6. RISK ASSESSMENT AND MITIGATON

6.01 Some potential risks associated with project implementation and operation as well as potential mitigation measures are summarised in Table 3 below.

TABLE 3: RISK ASSESSMENT AND MITIGATION

Risk Type	Description of Risk	Mitigation Measures
Implementation	Weak levels of participation of key partners/collaborators.	CIMH will use the existing EWISACTS consortium that include key regional partners to promote their participation and involvement in the project.
Operation	Limited application of the skills aquired by participans from the training workshops to the design, development and delivery of adequate climate products and services.	CIMH will continue to promote initiatives such as the Caribbean Climate Outlook Forum and the EWISACTS consortium to facilitate the interactions between producers and users of climate information, thereby ensuring that climate products and services are tailored to the user needs.

7. COST AND FINANCING

7.01 The total cost of the project is estimated at nine hundred and sixty-seven thousand, seven hundred and twenty-five euros (EUR967,725). The summary of the Financing Plan is shown in Table 4 with a detailed budget shown at Appendix 8.

TABLE 4: SUMMARY OF FINANCING PLAN

CONTRIBUTORS	**EUR**	**%**
CDB	773,025	80
CIMH (in-kind)	194,700	20
TOTAL	**967,725**	**100**

8. FUNDING SOURCE

8.01 CDB grant to CIMH of an amount in the equivalent of EUR773,025 is eligible for financing from CDB SFR allocated from resources provided under the ACP-EU-CDB NDRM in the CARIFORUM Countries Programme. Funds are available within existing resources.

9. PROCUREMENT

9.01 Procurement shall be in accordance with the CDB Guidelines for Procurement (January 2006), for goods, works and non-consultancy services, and the CDB Guidelines for the Selection and Engagement of Consultants (October 2011) for consultancy services. Financing shall be provided under the ACP-EU-CDB NDRM in CARIFORUM Countries Programme Contribution Agreement and thus, in accordance with that agreement, eligibility shall be extended to countries which are eligible for procurement under EU-funded projects, which are not CDB Member Countries, in accordance with the EU Eligibility Rules set out in Appendix 9.

9.02 The International Centre on Environmental Monitoring "*Centro Internazionale in Monitoraggio Ambientale"* (CIMA) is coordinating the RASOR platform to perform multi-hazard risk analysis. The RASOR platform was successfully used in October 2016 to support modeling of the impact of Hurricane Matthew on the southern peninsula of Haiti. Therefore, given the continuation of its work on the coordination and use of the RASOR Platform and its exceptional experience and qualifications, in accordance with paragraph 3.9 of the aforementioned CDB Guidelines for the Selection and Engagement of Consultants, CIMA shall be single-sourced to strengthen CIMH's capacity to perform impact analysis through the RASOR platform.

9.03 The Procurement Plan is shown at Appendix 10. Any revisions to the Procurement Plan will require CDB's prior approval in writing.

10. REPORTING REQUIREMENTS

10.01 CIMH will be required to submit to CDB, in form and substance acceptable to CDB, the reports described at Appendices 2A to 2E and 7.

11. RECOMMENDATION

11.01 It is recommended that CDB make a grant to CIMH of an amount not exceeding the equivalent of seven hundred and seventy-three thousand, and twenty-five euros (EUR773,025) from CDB's SFR (the Grant) allocated from resources provided under the ACP-EU-CDB NDRM in the CARIFORUM Countries Programme, to assist CIMH in financing consultancy services and the procurement of good and services for "Enhancing Weather and Climate Early Warning Systems and Impacts-Based Forecasting Platforms in the Caribbean", on CDB's standard terms and conditions, and on the following Terms and Conditions:

(1) Disbursement:

Except as CDB may otherwise agree, and subject to paragraph (b) below, payment of the Grant shall be made as follows:

(a) an amount not exceeding the equivalent of two hundred and thirty-one thousand, nine hundred and eight euros (EUR231,908) of the Grant shall be paid as an

advance (the Advance) on account of expenditures in respect of the Grant, following receipt by CDB of:

(i) a request in writing from CIMH for such funds; and

(ii) evidence acceptable to CDB, that the condition precedent to first disbursement of the Grant set out in sub-paragraph (3) below has been satisfied; and

(b) the balance of the Grant shall be paid periodically, by way of further advances (each, a subsequent advance), on account of expenditure in respect of the Project, following receipt by CDB of an account and documentation satisfactory to CDB with respect to each preceding advance, provided however, that CDB shall not be under any obligation to make:

(i) the first such subsequent advance until CDB shall have received an account and documentation satisfactory to CDB, in support of expenditures incurred by CIMH with respect to the Advance;

(ii) any subsequent advance until CDB shall have received the requisite number of copies of the reports, in form and substance acceptable to CDB, to be furnished for the time being by CIMH and the PC, in accordance with the TOR set out at Appendix 1A; and

(iii) payments exceeding six hundred and ninety-five thousand, seven hundred and twenty-three euros (EUR695,723) representing ninety percent (90%) of the Grant until CDB shall have received the requisite number of copies of the final report in form and substance acceptable to CDB, required to be furnished by CIMH and the PC in accordance with the TOR set out at Appendix 1A and a certified statement of the expenditures incurred in respect of, and in connection with, the Project.

(2) Period of Disbursement:

The first payment of the Grant shall be made by September 1, 2017, and the Grant shall be fully disbursed by August 30, 2019, or such later dates as CDB may specify in writing.

(3) Condition Precedent to First Disbursement of the Grant:

The PC referred to in sub-paragraph (5)(b)(i) below shall have been assigned.

(4) Procurement:

(a) Procurement shall be in accordance with the procedures set out and/or referred to in the Grant Agreement between CDB and CIMH or such other procedures as CDB may from time to time specify in writing. The Procurement Plan approved by CDB is set out at Appendix 10. Any revisions to the Procurement Plan shall require CDB's prior approval in writing.

(b) In accordance with the requirements of the ACP-EU-CDB NDRM in CARIFORUM Countries Programme Contribution Agreement, country eligibility

shall be extended to countries which are eligible for procurement under EU-funded projects, which are not CDB Member Countries.

(5) Other Conditions:

(a) Except as CDB may otherwise agree, the Grant shall be executed by CIMH.

(b) CIMH shall:

(i) assign a member of its staff as PC who shall be responsible for coordinating the implementation of the Project, including the carrying out of the functions described in the TOR set out at Appendix 2. The qualifications and experience of any person subsequently appointed as PC shall be acceptable to CDB;

(ii) in accordance with the procurement procedures applicable to the Grant select and engage consultants to carry out the services set out in the TOR at Appendix 3B;

(iii) in all relevant workshops, publications, correspondence, advertisements and promotions associated with the Grant, use its best endeavours to openly acknowledge EU's and CDB contribution to the Project; and

(iv) submit to CDB, in form and substance acceptable to CDB, the reports set out in Appendix 3 to this Paper within the periods stipulated therein.

(c) Except as CDB may otherwise agree, CIMH shall:

(i) meet, or cause to be met:

(aa) the cost of the items designated for financing by CIMH in the Budget;

(bb) any amount by which the cost of the Grant exceeds the estimated costs set out in the Budget; and

(cc) the cost of any other items needed for the purpose of, or in connection with, the Grant; and

(ii) provide all other inputs required for the punctual and efficient carrying out of the Grant not being financed by CDB.

(d) CDB shall be entitled to suspend, cancel or require a refund of the Grant, or any part thereof, if there shall have been a failure by the EU to provide the whole or any part of their contribution, except that CIMH shall not be required to refund any amount of the Grant already expended by CIMH in connection with the Grant and not recoverable by it.

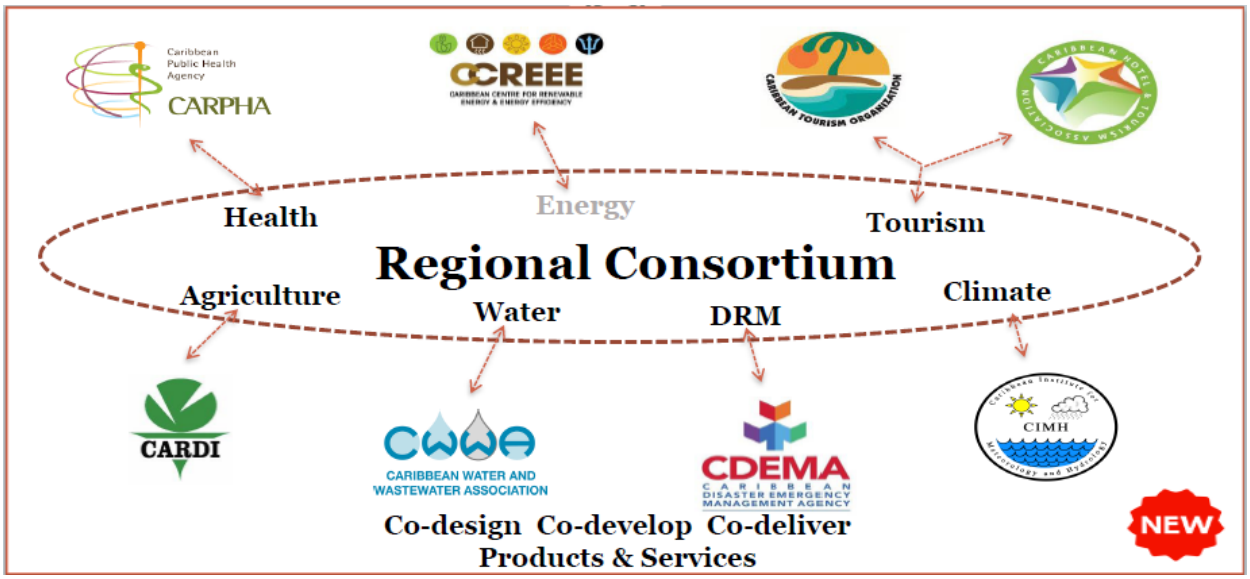
SUPPORTING DOCUMENTATION

Appendix 1	Regional Integrated Climate Services Model - EWISACTS Coordination Partners.
Appendix 2A	Draft Terms of Reference: Weather Research and Forecasting Model Training
Appendix 2B	Draft Terms of Reference: Marine Forecaster Training and Feasibility Study for a Regional Marine Forecasting Centre
Appendix 2C	Draft Terms of Reference: Climate Early Warning for Mosquito Vector, *Aedes aegypti*, Proliferation
Appendix 2D	Draft Terms Of Reference: RASOR Platform Training and Implementation Pilot
Appendix 2E	Draft Terms of Reference: Building the Capacity of Young Professionals in Climatology, Meteorology, Hydrometeorology and Related Fields
Appendix 3	Design and Monitoring Framework
Appendix 4	Performance Rating System
Appendix 5	Gender Marker Analysis
Appendix 6	Work Implementation Schedule
Appendix 7	Duties and Responsibilities: Project Coordinator
Appendix 8	Detailed Budget
Appendix 9	EU Eligibility Rules
Appendix 10	Procurement Plan

APPENDIX 1

TECHNICAL ASSISTANCE - EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN

REGIONAL INTEGRATED CLIMATE SERVICES MODEL
THE CONSORTIM OF REGIONAL SECTORAL EARLY INFORMATION SYSTEMS ACROSS CLIMATE TIMESCALES (EWISACTS) COORDINATION PARTNERS



APPENDIX 2A

TECHNICAL ASSISTANCE- EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN

DRAFT TERMS OF REFERENCE
WEATHER RESEARCH AND FORECASTING MODEL TRAINING

1. INTRODUCTION

1.01 Meteorological services globally are being challenged by an increasing number of hydro-meteorological and climate related disasters. The socio-economic losses from these disasters are in the order of billions of United States dollars, and loss of life in the hundreds to thousands depending on the regions impacted. The magnitude of the losses from these events is driving the call for improved integrated early warning systems that address fundamental questions such as (a) where will the event occur? (b) what will be the nature of the event? (c) what is the expected start time and duration of the event? and (d) what are the expected impacts and losses from the event?

1.02 Key to addressing the questions posed above is the hydro-meteorological forecast. Within the last two decades, hydro-meteorological forecasts have undergone significant improvements that have improved their accuracy. It is now an industry expectation to produce accurate hydro-meteorological forecasts 72-96 hours in advance. Central to this improvement are significant advancements in numerical weather prediction models, advances in computing platforms and decreasing computational costs.

1.03 Within the Caribbean, the Caribbean Institute for Meteorology and Hydrology (CIMH) has been playing a critical role in deploying numerical weather prediction models to improve hydro-meteorological forecasts at national and regional levels. Starting in 2006, the CIMH first deployed operationally the MM5 numerical weather prediction model across the Caribbean region at 18 kilometre (km) and 54 km resolutions. The benefits of this implementation to regional forecasting was significant especially for tracking and predicting fairly large scale weather systems. In 2008, the CIMH added the Weather Research and Forecasting (WRF) Model also running at 18km and 54km resolutions into its modeling platform. This inclusion allowed inter-model comparisons to be performed by hydro-meteorological forecasters to further improvements in weather forecasts issued by National Meteorological and Hydrological Services (NMHSs) in the Caribbean.

1.04 The 18 km and 54 km resolution model outputs were particularly suited to regional level forecasting but were too coarse to capture local weather features at the watershed scale for most island states in the Caribbean. In 2010, immediately following the Haiti earthquake, the CIMH deployed a 4 km resolution model local to Haiti using the WRF ARW platform. The goal of the implementation was to predict severe hydro-meteorological events at the watershed level as part of an early warning system that may adversely impact search, rescue and recovery efforts. Outputs from the platform were incorporated into the planning activities of many organisations operating in Haiti including the International Red Cross and Red Crescent Societies.

1.05 In 2011, building on the experience of Haiti, the CIMH introduced twice daily 4km 48 hour WRF ARW region-wide simulations which allowed NMHSs to track rainfall in their areas of responsibility at the watershed level. Since 2011, run times for the WRF-based simulations have decreased from approximately 20 hours to approximately 4 hours as new computational hardware has been acquired. Improvements in computational efficiency coupled with the decreasing cost of computational platforms is providing a compelling case for NMHSs in the Caribbean to consider running their own sub 4 km local area numerical weather prediction models. Indeed, the Belize National Weather Service currently runs a 5 km resolution

version of WRF over Belize. Other NMHSs have indicated a desire to follow this trend but using CIMH outputs to drive their local forecast models.

1.06 To facilitate countries with their numerical weather prediction ambitions, the CIMH as the World Meteorological Organisation (WMO) Regional Training Centre for the Caribbean is obligated to provide them with the required level of training needed to successfully integrate numerical weather prediction into their forecasts through (a) in-class trading in the Senior Level Meteorology Technicians' course; and (b) an online continuing professional development course focused on teaching NMHSs forecasters how to integrate numerical weather predictions into forecasts. This proposal seeks to advance this process by providing NMHSs with the requisite skills to use the WRF to build their own local area numerical weather prediction models.

2. ABOUT THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY

2.01 CIMH is an institution of the Caribbean Community and the technical organ of the Caribbean Meteorological Organisation (CMO). The mandate of the CIMH is to assist in improving and developing the meteorological and hydrological services as well as, providing the awareness of the benefits of meteorology and hydrology for the economic well-being of the 16 CMO Member States. This is achieved through training, research, investigations, and the provision of related specialised services and advice.

2.02 In achieving its mandate, the CIMH has established an affiliation with the University of the West Indies where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is also recognised by the WMO as: (a) the WMO regional training centre in the Caribbean for meteorology and hydrology and related disciplines; (b) a regional instrument centre for the Caribbean; (c) Centre of Excellence in satellite meteorology training; and (d) the WMO Regional Climate Centre for the Caribbean.

2.03 In addition, the CIMH is a repository for the climate data from CMO Member States. The institute is also an important Caribbean centre for research and development related to meteorology, hydrology, agro-meteorology and climate in the Caribbean. It is active in such areas of hydrological risk impacts forecasting and agricultural risks forecasting and has had strong collaborations with other regional institutions, national organisations in CMO Member States and the international community.

3. OBJECTIVES

3.01 The objective of this proposal is to build regional capacity to implement the WRF Modeling Platform at the national level to support operational hydro-meteorological forecasting. It is expected that operationalisation of the Platform will improve the accuracy of national hydro-meteorological forecasts.

3.02 It is also expected that persons trained under this effort will be able to use the WRF Platform to reanalyse historical weather systems to better understand their genesis and impacts to strengthen national level early warning processes and impacts forecasting efforts.

4. SCOPE OF WORK

3.01 Twenty persons from CIMH, UWI and NMHS in Borrowing Member Countries (BMCs) (Antigua and Barbuda, Bahamas, Barbados, Belize, Guyana, Haiti, Jamaica, Saint Lucia and Trinidad and Tobago) trained to operationalise the WRF platform at the national levels. It is expected that attendees will be taught:

(a) the basics of numerical weather prediction systems including the underlying equations and assumptions;

(b) the basics of the WRF Modeling Platform with introductions to WRF-Chemistry Model, WRF-Hydrology Model etc.;

(c) how to install either WRF-Advanced Research WRF and/or WRF-Non-hydrostatic Mesoscale Model Modeling Platforms, associated core software including Network Common Data Form and Open-Message Passing Interface and post-processing software;

(d) how to run the WRF system - data download, data preprocessing, execution of the WRF Platform and post-processing of the model outputs;

(e) how to select appropriate model parameterisation schemes through calibration activities; and

(f) how to interpret model outputs.

4. QUALIFICATIONS AND EXPERIENCE

5.01 The successful Trainer is required to have recognised credentials (with strong preference being given to candidates with MSc and PhD degrees) in either Meteorology, Physics and/or Applied Mathematics. Candidates with degrees in other related fields will be given consideration based on their experience. In addition, the successful trainer must have:

(a) more than ten years of experience delivering training in area of atmosphere modeling and the application of numerical models to hydro-meteorological and impacts forecasting;

(b) at least five years experience implementing WRF Platforms;

(c) awareness of the challenges associated with hydro-meteorological and impacts forecasting on SIDS; and

(d) experience working with developing countries and in particular SIDS.

5. REPORTING REQUIREMENTS AND DELIVERABLES

6.01 The successful Trainer will be expected to deliver the following:

(a) an Inception Report delivered three weeks following the completion of the contracting process. The report should include a Work Plan, minimum requirements for students to take part in the course, certification for course participants, and hardware and software requirements for the course;

(b) training syllabus delivered five weeks after the completion of the contracting process;

(c) delivery of a Training Manual for the course eight weeks after the completion of the contracting process; and

(d) a post Training Report.

APPENDIX 2B

EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN

DRAFT TERMS OF REFERENCE

MARINE FORECASTER TRAINING AND FEASIBILITY STUDY FOR A REGIONAL MARINE FORECASTING CENTRE

1. INTRODUCTION

1.01 Small Island Developing States (SIDS) are defined as largely coastal as they have a large coastal area to land mass ratio. This often means that SIDS have marine exclusion zones and related resources that are significantly greater than their land mass. As a result, the coastal and marine environment plays a critical role in the evolution of nearly all aspects of SIDS including their socio-economic development.

1.02 Marine ecosystems in the Caribbean face constant and significant threats from weather and climate events that can degrade seriously the halieutic resources and, consequently, endanger their sustainability. Despite the importance of these resources for the socio-economic development of SIDS, daily to seasonal marine forecasting capabilities in the Caribbean remain extremely limited. However, information at these time scales is critical for operational planning in many marine related sectors including fisheries, energy, transportation and tourism. While many National Meteorological and Hydrological Services (NMHSs) of the Caribbean Meteorological Organization (CMO) Member States issue marine forecasts, the information is frequently derived from external sources and not always at the spatial and temporal scales suitable for use by many of the smaller Caribbean SIDS to provide detailed marine conditions at all locations along their coast lines.

1.03 Recognising this gap in knowledge and knowhow related to marine forecasting and the increasing value of marine forecasts to livelihoods, reduction in loss of life and overall economic activity of many states in the Caribbean, the Caribbean Institute for Meteorology and Hydrology (CIMH) at the urging of NMHSs in Member States of the CMO teamed with the Caribbean Disaster and Emergency Management Agency and the United Kingdom Meteorological Office (UK Met Office) to deliver a marine forecasting course to the region. The two week course delivered by the UK Met Office, which provided participants with basic skills in marine forecasting was well received with many encouraging follow up training in the area and increased access to high resolution regional marine forecasts, to drive and inform national marine forecasts. While some of the knowledge and know-how acquired in the course has been incorporated into CIMH training programmes, no new significant initiatives to expand and improve the marine forecasting capabilities of NMHSs have been undertaken even though the need is great.

1.04 Since the initial offering, CIMH has been seeking additional opportunities to deliver a follow-up course in marine forecasting for persons in NMHSs. These would include (a) introductory courses similar to that previously delivered and particularly focused on building the capacity of meteorological forecasters with little background in marine forecasting, (b) mid-level courses for meteorological forecasters who took the previous course or have taken recent courses in marine forecasting offered by CIMH, and (c) advance-level courses in marine forecasting for those persons with mid-level experience in marine forecasting.

1.05 The provision of operational regional marine forecasts for marine related socio-economic activities is currently not assigned to any egional institution. However, the activity is closely aligned to the mandate of the CMO. The WMO is actively engaged at the global level with shaping the delivery of marine meteorological forecasts. For example, Annex VI to the WMO Technical Regulations, the Manual on

Marine Meteorological Services (WMO-No. 558, Volume I) documents the regulatory process for providing marine meteorological services. Included in the regulations are the provision of services for high seas, coastal and offshore areas, main ports and harbour areas, and training in the field of marine meteorology (covering not only NHMS personnel, but also seafarers and marine observers on board ships). The World Meteorological Organization (WMO) also publishes and makes available to NMHSs the Guide to the Marine Meteorological Services (WMO-No. 471), as well as, the Guide to Wave Analysis and Forecasting (WMO-No. 702) and Guide to Storm Surge Forecasting (WMO-No. 1076). Weather Reporting (WMO-No. 9), Volume D – Information for Shipping is regularly updated by the WMO Secretariat as part of the World Weather Watch (Operational Information Service.

1.06 The CMO and its precursors have enjoyed a close partnership with the WMO going back more than 50 years with CMO facilitating the implementation of WMO programmes in the Region. The establishment of the Caribbean Meteorological Institute (CMI), now the CIMH, is a product of this partnership. As a result, it is logical that the CMO should play a critical role in advancing WMO's marine programmes and regulations in the Caribbean. Whereas CMO Headquarters Unit is perhaps best placed to support the implementation of WMO regulatory processes in the region, CIMH is well placed to advance the operational aspect of a marine forecasting programme for the region using the guidance contained in the referenced WMO documents - e.g., WMO-No. 471, WMO-No. 702, WMO-No. 1072 and possibly WMO-No. 9.

1.07 Some of the activities outlined in the previous paragraph have already begun. As noted earlier, CIMH has commenced building marine forecasting capacity in its programme as well as within NMHSs. Recognising the risks posed to coastal communities, commercial sectors and infrastructure by storm surge, CMI partnered with the United States Agency for International Development (USAID) and the Organization of American States (OAS) under the Caribbean Disaster Mitigation Project in 1998 to develop the region's capacity to predict and assess the impacts of storm surge and wave action along coastal areas in the Caribbean through the introduction of the Total Arbiter of Storms (TAOS/L) model. The model was used to inform national governments of expected storm surge along their coasts up until 2008 when it was replaced by the online package TAOS Real Time Forecasting System (TAOS-RTFS) produced by Kinetic Analysis Corporation (KAC) and made available to Caribbean Catastrophe Risk Insurance Facility (CCRIF) participating states with annual training provided to NMHSs and the disaster management community by CIMH. Outputs from the TAOS-RTFS system are routinely integrated into the Caribbean DEWETRA Platform to support CIMH's impact forecasts associated with tropical storms.

1.08 As part of the Reduced Risk to Human and Natural Assets Resulting from Climate Change (RRACC) project funded by USAID and implemented by the Organisation of Eastern Caribbean States (OECS) Secretariat, OEA Technologies Incorporated was commissioned to designing and implementing a regional marine monitoring and forecasting system for the OECS. The OEA Technologies Incorporated report of 2013 noted that while climate change and associated sea-level rise were high priorities for the OECS, there was very limited marine monitoring and forecasting services in the Eastern Caribbean. The report noted that with regards to marine monitoring, there were three sea-level monitoring sensors present in the OECS that were operated by international entities [it is important to note that as of March 2017, the International Oceanic Commission Sea Level Monitoring Facility (http://www.ioc-sealevelmonitoring.org/list.php) indicates that almost every OECS has at least one real-time reporting sea level monitoring gauge]. The report noted that monitoring of other parameters important for coastal zone management and marine safety such as ocean acidification, wave and current direction and velocity were absent. While the report noted that no organisation is forecasting storm surge as well as wave and current conditions, this is not quite accurate as the storm surge forecasts from KAC TAOS-RTFS Platform have been available for the entire Caribbean prior to 2013. The report is nevertheless quite accurate in asserting that little has been done within the Region with the data currently being recorded in the Region even though

the data is readily accessible. The report concludes that this lack of use of the data by the Region is the result of the limited human resources available in the Region to convert the data to useful products.

1.09 The OEA Technologies Incorporated report further notes the absence of agencies with no clear mandate to engage in marine monitoring and forecasting on an operational basis within the OECS. The report recommended that in terms of initiating institutional arrangements to operationalise a marine monitoring and forecasting system for the OECS, that a "Regional Meteorology and Oceanography Service" consisting of the six national meteorological services involved in the RRACC programme and CIMH. With this approach, it was recommended that CIMH expands its capacity to include development of marine modelling services, and the six national meteorological offices expand their forecasting capabilities to include a regional storm-surge forecast. While the focus of the study was the OECS, the proposed model could be expanded to the greater Caribbean with the capabilities of the NMHSs expanded beyond storm-surge forecasts.

1.10 Recognising the daily risks posed by marine conditions to marine-based sectors, as well as, the report of OEA Technologies Incorporated, CIMH in 2015 operationalised an implementation of the WaveWatch-3 marine wave modeling software over a large area covering the Caribbean Sea and adjacent oceans. Operational model runs of seven days at 4 kilometres resolution are initiated twice per day using global datasets to initialise and establish relevant boundary conditions. Outputs from this system are ingested into the Caribbean DEWETRA Platform to support impact forecasts as well as made available on CIMH website for use by the general public. Over the last two years the system has been extensively used to support the disaster management community including the assessments of the potential impacts of large waves triggered by: (a) Hurricane Matthew on the southwestern peninsula of Haiti, the northern coastline of Jamaica, the Bahamas and the Turks and Caicos Islands; (b) Hurricane Joaquin on the southern Bahamas; and winter swells on islands in the Caribbean. With regards to Hurricane Joaquin, a post impact analysis was performed to assess and confirm the wind and marine conditions at the time of the disappearance of the El Faro. This analysis is guiding how the modeling system can be used to risk-inform marine and coast guard operations in the Region. In addition, other applications of the platform are being examined including applications to marine security, the energy sector, marine search and rescue and marine pollution and clean up.

1.11 Since May 2017, CIMH has formally hosted the WMO Regional Climate Centre for the Caribbean. This operational centre is primarily focused on the development and delivery of climate services to regional stakeholders in the health, energy, water, disaster risk reduction, tourism, agriculture and food security sectors. Included in the products and services currently being delivered by the Regional Climate Center (in demonstration phase) are (a) seasonal predictions of sea surface temperature across the Caribbean Sea and adjacent oceans and (b) three and four-month forecasts of coral bleaching in coastal regional. It is expected that in the future, these products can be expected to include the marine climatology for the region as well as possible three month wave predictions for the region.

1.12 Since 2000, CIMH has built experience installing and maintaining marine observation platforms. CIMH was an active participant in the establishment of the sea level monitoring network for the Caribbean established under the Caribbean Planning for Adaptation to Climate Change project implemented by the World Bank and executed by the OAS during the period 1997-2001. Under the project, several staff (a) supported the installation of 18 sea level stations at various locations across the Caribbean and (b) supported the monitoring and maintenance of the network. While it was expected that CIMH would support the archiving of data collected by the network, this action was never realised. Unfortunately, the system suffered from a series of hardware malfunctions which limited its usefulness and sustainability. In 2006, the CIMH supported the Caribbean Community Climate Change Centre attempt to reestablish the Caribbean sea level monitoring network by re-occupying 8 of the 18 previously occupied locations. Unfortunately, many of the stations were not sustained by local authorities and several suffered damage

from storms and marine craft. In 2012, CIMH worked with the United States National Oceanographic and Atmospheric Administration (NOAA) to reinstall sea-level monitoring stations at several of these locations as part of a regional tsunami early warning platform. In recent years, CIMH has worked with the Barbados Coastal Zone Management Unit to install ocean monitoring buoys off the coast of Barbados.

2. ABOUT THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY

2.01 CIMH is an institution of the Caribbean Community and the technical organ of the CMO. The mandate of CIMH is to assist in improving and developing the meteorological and hydrological services as well as, providing the awareness of the benefits of meteorology and hydrology for the economic well-being of the 16 CMO Member States. This is achieved through training, research, investigations, and the provision of related specialised services and advice.

2.02 In achieving its mandate, CIMH has established an affiliation with the University of the West Indies where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is also recognised by the WMO as: (a) the WMO Regional Training Centre in the Caribbean for meteorology and hydrology and related disciplines; (b) a regional instrument centre for the Caribbean; (c) centre of excellence in satellite meteorology training; and (d) the WMO regional climate centre (in demonstration phase) for the Caribbean.

2.03 In addition, CIMH is a repository for the climate data from CMO Member States. The institute is also an important Caribbean centre for research and development related to meteorology, hydrology, agro-meteorology and climate in the Caribbean. It is active in such areas of hydrological risk impacts forecasting and agricultural risks forecasting and has had strong collaborations with other regional institutions, national organisations in CMO Member States and the international community.

3. OBJECTIVES

3.01 The primary objectives of this assignment are to (a) strengthen operational marine forecasting across the region and in particular the member states of CIMH and borrowing member countries of the Caribbean Development Bank, and (b) explore the viability of CIMH to host a marine forecasting centre for the Caribbean.

4. SCOPE OF WORK

4.01 The activities envisioned to deliver the desired outputs will be supported by a consultancy. Specific duties and responsibilities of the Consultant include:

(a) building the capacity of NMHSs to make and issue local marine forecasts through the development and delivery of entry and mid-level training course in areas of marine forecasting. It is expected that the training courses would consist of a mixture of face-to-face and online training modules with the face-to-face exercise lasting at least one week;

(b) strengthening CIMH's capacity to develop and deliver face-to-face and online training programmes in marine meteorology forecasting to NMHSs and the stakeholders across the Caribbean. The Consultant will develop and deliver specialised in-house training programmes for CIMH staff. The Consultant will also identify at least one international course or programme that at least one member of staff can attend to further strengthen their background and skills in marine forecasting;

(c) strengthening CIMH's capabilities to deliver marine forecasting products and services to a broad range of stakeholder. The Consultant will work with CIMH staff to identify the potential market for marine products and services and work with staff to pilot products to some potential clients;

(d) explore the viability of CIMH to host a marine forecasting centre for the Caribbean region noting the report of OEA Technologies Incorporated. The Consultant will be required to assess whether CIMH is a suitable candidate to host a marine forecasting centre for the Caribbean region. The Consultant will be required to evaluate CIMH's ability to sustain such a centre based on its current resources and, based on the outcome of the evaluation, development an appropriate business plan for CIMH to sustain the operations of such a regional centre.

5. QUALIFICATIONS AND EXPERIENCE

Marine Meteorology Training (Introductory, Intermediate and Advanced Courses)

5.01 The successful Consultant is required to have recognised credentials (with strong preference being given to candidates with MSc and PhD degrees) in either Meteorology, Marine Science, Oceanography or related disciplines. In addition, the successful Trainer must have:

(a) more than ten years of experience delivering training in areas of marine forecasting and the development of marine forecasting products to a broad range of stakeholders;

(b) experience building marine forecasting programmes and related centres; and

(c) experience working with developing countries.

Marine Meteorology Satellite Training

5.02 The successful Consultant is required to have recognised credentials (with strong preference being given to candidates with MSc and PhD degrees) in either Meteorology, Marine Science, Oceanography, Remote Sensing or related disciplines. In addition, the successful Consultant must have:

(a) more than ten years of experience delivering training in areas of marine satellite marine forecasting and the development and delivery of related products for a broad range of stakeholders;

(b) experience working in Developing and Least Developed Countries including SIDS;

(c) experience working with satellite operators; and

(d) experience working with or contributing to the WMO Virtual Laboratory would be an asset.

Assessment of CIMH's Capabilities to Host a Regional Marine Meteorology Forecasting Centre

5.03 The successful Consultant is required to have recognised credentials in either Meteorology, Marine Science, Oceanography or related disciplines. In addition, the successful Consultant should have demonstrated experience:

(a) evaluating and assessing marine forecasting centres or establishing such centres;

(b) experience working in Developing and Least Developed Countries including SIDS; and

(d) experience developing funding proposals, business development strategies and sustainability plans for such institutions.

6. REPORTING REQUIREMENTS AND DELIVERABLES

6.01 The Consultant will deliver the:

(a) training syllabi for entry-level and mid-level marine forecaster training courses as well as time table for the training;

(b) report on face-to-face training on marine forecasting at the CIMH office in Barbados, as well as, conduct online training;

(c) training syllabi for internal training programme for CIMH staff along with identification of a proposed programme for advanced study for at least one member of staff;

(d) report on training programme for CIMH staff and new products that could be delivered by CIMH to regional stakeholders; and

(e) report on the feasibility of CIMH becoming a regional marine forecasting centre including business development and sustainability considerations for the centre.

7. DURATION

7.01. The assignment is expected to be completed within one year.

APPENDIX 2C

TECHNICAL ASSISTANCE - EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN
DRAFT TERMS OF REFERENCE

DEVELOPMENT OF CLIMATE EARLY WARNING FOR MOSQUITO VECTOR, AEDES AEGYPTI, PROLIFERATION

1. INTRODUCTION

1.01 Small island developing states (SIDS) are extremely vulnerable to the impacts of climate variability and change. Many SIDS have been experienced high socio-economic burdens from climate-sensitive health outcomes, including morbidity and mortality from extreme events related to vector, food and waterborne diseases. Climate variability is a significant environmental driver of vector-borne diseases such as Yellow Fever, Dengue Fever, Chikungunya and Zika which, at various times, have encumbered national health care and productivity systems in the Caribbean. For instance, it is estimated that Dengue Fever costs the Caribbean about USD321 million annually[1]. The Caribbean remains the area within the Americas with the highest cost per capita (International dollars $8.70) (Shepard, Coudeville, Halasa, Zambrano, and Dayan, 2011) with about 9,000 years of lost time due to ill health and premature deaths[2] as a result of dengue. The health sector in the Caribbean SIDS will likely see increases in climate related health impacts under predicted future climate.

1.02 Yellow Fever, Dengue Fever, Chikungunya and Zika in the Caribbean share a common vector, the *Aedes aegypti* mosquito whose proliferation is climate sensitive. Tropical and sub-tropical climate conditions allow the *Aedes aegypti* mosquito to thrive during warmer, wetter and more humid months and the distribution and abundance of that vector may be affected by even small changes in ambient temperature and precipitation. In the Caribbean, prior research observed a link between past climate trends, increased mosquito incidence and Dengue Fever Risk. For example, Dengue Fever occurrence in the Caribbean is known to follow a seasonal pattern to a large extent, with most cases occurring during the second half of the year when temperatures are warm and precipitation and humidity high (Taylor et al, 2009)[3].

1.03 In the Caribbean, there is a need to invest more resources to better understand climate risks in the health sector and to develop effective and efficient mitigation strategies. While understanding climate risk in the health sector across all timescales is an aspirational goal, building models and frameworks to understand climate health risks at short time scales (seasonal and sub-seasonal scales) where climate predictions are better constrained represents a reasonable confidence-building approach that could pay substantial dividends. The development of models to predict climatic conditions favourable to the proliferation, spatial and temporal distribution of the population of mosquito vector, *Aedes aegypti*, is a key step towards the vector surveillance and control. This would alert the public health systems for adequate responses to reduce the incidences of mosquito-borne viral infection.

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[1] Source: https://sta.uwi.edu/uwitoday/archive/april_2013/article6.asp. This estimate does not consider the costs of surveillance, mosquito control and public education programmes or the impact of disruption to the rest of the healthcare system when an outbreak occurs.

[2] Source: http://www.guardian.co.tt/news/2013-03-25/dengue-costs-caribbean-us321m-year.

[3] Taylor M. A., A. A. C., and W. Bailey, (2009). Review of Health Effects of Climate Variability and Climate Change in the Caribbean (M. A. T. C. C. Project, Trans.) (pp. 85). Belmopan, Belize: Caribbean Community Climate Change Centre (CCCCC).

2. ABOUT THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY

2.01 Caribbean Institute for Meteorology and Hydrology (CIMH) is an institution of the Caribbean Community and the technical organ of the Caribbean Meteorological Organisation (CMO). The mandate of CIMH is to assist in improving and developing the meteorological and hydrological services as well as, providing the awareness of the benefits of meteorology and hydrology for the economic well-being of the 16 CMO Member States. This is achieved through training, research, investigations, and the provision of related specialised services and advice.

2.02 In achieving its mandate, CIMH has established an affiliation with the University of the West Indies where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is also recognised by the World Meteorological Organisation (WMO) as: (a) the WMO regional training centre in the Caribbean for meteorology and hydrology and related disciplines; (b) a regional instrument centre for the Caribbean; (c) centre of excellence in satellite meteorology training; and (d) the WMO regional climate centre (in demonstration phase) for the Caribbean.

2.03 In addition, CIMH is a repository for the climate data from CMO Member States. The institute is also an important Caribbean centre for research and development related to meteorology, hydrology, agro-meteorology and climate in the Caribbean. It is active in such areas of hydrological risk impacts forecasting and agricultural risks forecasting and has had strong collaborations with other regional institutions, national organisations in CMO Member States and the international community.

3. OBJECTIVES

3.01 The overall objective of this assignment is to develop a modelling framework to provide spatio-temporal probabilistic forecasts of *Aedes aegypti* proliferation. To achieve this objective, this technical assistance will adopt a comprehensive approach to develop/modify, calibrate and verify predictive models relating climate variables to spatial patterns of *Aedes aegypti* populations in at least two pilot countries drawn from Borrowing Member Countries (BMCs). The resulting models should facilitate the development of outlooks for the spatial and temporal distributions of populations of *Aedes aegypti* for at least up to three months with a zero month lead time, using information on the climatic conditions for the Caribbean. The outputs of the models should provide probabilistic maps that can be used for vector surveillance and control.

3.02 The consultancy should also facilitate:

(a) the development of regional and international collaborations to support long term research and development of climate early warning systems for vectors that pose health threats; and

(b) a capacity building exercise in health-climate spatio-temporal model development for regional and national representatives.

4. SCOPE OF WORK

4.01 The scope of work is understood to cover all activities necessary to accomplish the objectives of the consultancy, whether or not a specific activity is cited in these Terms of References. A participatory and consultative approach with the national focal agencies and regional key collaborators, particularly Caribbean Public Health Agency (CARPHA), Pan American Health Organization (PAHO) and CIMH, must be adopted in the conduct of these services. Specific duties and responsibilities of the Consultant include but are not limited to:

(a) in collaboration with CARPHA and CIMH, define the methodology, including potential models that will be considered for the study, for conducting the research including development of the criteria for the selection of two pilot countries drawn from BMCs for the study;

(b) update the methodology, including potential models that will be considered for the study, if required, based on available data, feedback from the pilot countries and regional partners including CIMH, CARPHA and PAHO among others;

(c) demonstrate the approach in the two pilot countries;

(d) prepare a Draft Report on the study and conduct in-country workshops to share the draft findings with national and regional stakeholders;

(e) conduct a regional training workshop to train regional and national experts on how to conduct similar studies and products; and

(f) prepare a Final Report.

5. QUALIFICATIONS AND EXPERIENCE

5.01 The Consultant is required to have recognised credentials in Epidemiology, Public Health and or Statistics with demonstrated experience conducting similar assessment studies:

(a) more than ten years of experience conducting climate related vector studies with preferred experience in areas related to climate and the mosquito vector;

(b) more than five years experience training persons to conduct similar assessments; and

(c) experience working with developing countries and or SIDS with preferred experience working in the tropics.

6. REPORTING REQUIREMENTS AND DELIVERABLES

5.01 The following deliverables are envisioned for this project:

(a) an Inception Report detailing the proposed workplan and strategy for completing the work within three weeks following the signing of the contract;

(b) a Methodology Report inclusive of data needs and results of country visits and meetings with regional stakeholders within four months following the submission of the Inception Report;

(c) a Draft Modeling Report within three and a half months following the submission of the Methodology Report;

(d) a Model Report within one and a half months following the submission of the Draft Modeling Report;

(e) a Report on capacity building workshops (two national workshops and one regional workshop) within a month following the submission of the Model Report; and

(f) Final Project Report within one month following the submission of the Report on capacity building workshops.

7. DURATION AND WORKPLAN

7.01 The assignment is expected to be completed within one year.

APPENDIX 2D

EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN DRAFT TERMS OF REFERENCE

RASOR PLATFORM TRAINING AND IMPLEMENTATION PILOT IN BARBADOS AND HAITI

1. INTRODUCTION

1.01 Hydro-meteorological (hurricane, flooding, drought) and geophysical (earthquake, volcanoes, landslide, tsunami) hazards pose significant challenges to the socio-economic development of the Caribbean countries. Hydro-meteorological hazards are the most prevalent with their frequency and intensity expected to increase due to global climate change. Earthquake and volcanoes are less frequent, but such events can cause high level of socio-economic impacts. In the Caribbean, the lack of data on vulnerability and hazards has constrained effective disaster risk management. Recognising these deficiencies the Caribbean Institute for Meteorology and Hydrology (CIMH) along with the International Centre on Environmental Monitoring (CIMA) Research Foundation co-implemented activities of the project "Enhancing Resilience to Reduce Vulnerability in the Caribbean", which was co-executed by the United Nations Development Programme Office for Barbados and the Organisation of Eastern Caribbean States. This resulted in the CIMH establishing and maintaining the Caribbean DEWETRA Platform, a geo-spatial data fusion platform that integrates near real-time hazard data, geo-located infrastructure and assets, hazard maps, population demographics, physiographic characteristics and impact data. The platform supports impact-based forecasting and the rapid identification of evolving risk. Notwithstanding, there remains a need for capacity building to support scenario driven risk calculations and economic impact forecasting to further inform risk preparedness actions and mitigation strategies in the Caribbean.

1.02 The provision of economic impact analyses and risk-based forecasting is subject to the availability of hazard specific vulnerability and loss exceedance data. This data is developed through the collation of damage/loss data related to the strength or intensity of the hazard in relation to the exposed asset. Traditionally, such information is not collected regularly or with sufficient granularity to support the development of vulnerability and loss exceedance curves. In May 2017, the United Nations Office for Disaster Risk Reduction released its Assessment Report on Disaster Risk Reduction which contained loss exceedance curves for countries in the Caribbean among others. While this information can inform risk calculations, it should be seen as provisional and requires validation.

1.03 The Rapid Analysis and Spatialisation of Risk (RASOR) Platform (http://www.rasor-project.eu/) enables end users to perform multi-hazard risk analysis for the full cycle of disaster management including but not limited to targeted support, to critical infrastructure monitoring and climate change impact assessment. Despite the availability of operational mapping products, there is no single tool to integrate diverse data and products across hazards, update exposure data quickly and make scenario-based predictions to support both short and long term risk-informed decisions. RASOR offers a single work environment that generates new risk information across hazards, data types and user communities. A scenario-driven query system allow users to simulate future scenarios based on existing and assumed conditions, to compare with historical scenarios, and to model multi-hazard risk both before and during an event. RASOR enables users to go beyond risk identification and compute risk analyses and economic impacts regarding different hazard scenarios. The services offered by RASOR tools produce detailed and accurate risk information either through stand-alone remotely-sourced analysis or through the merging of earth observation and detailed ground based data sets according to the needs of the end user. RASOR is fully compliant with Open Geospatial Consortium standards which promote the distribution of data and

information and extensively uses web services based on free and open solutions.

1.04 The RASOR Platform was recently used to support modeling of the impact of Hurricane Matthew on the southern peninsula of Haiti. Wind fields from a numerical weather prediction (NWP) model were imported into the RASOR Platform which allowed for the computation of the impact caused by the wind gusts. Exposures were extracted from the Copernicus activation products and further characterised in the RASOR platform to assess vulnerability. The impact was computed for different sites in Haiti. For the western part of Haiti, comparison between the model estimate and the one derived from observation was within 20 percent.

2. ABOUT THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY

2.01 CIMH is an institution of the Caribbean Community and the technical organ of the Caribbean Meteorological Organisation (CMO). The mandate of CIMH is to assist in improving and developing the meteorological and hydrological services as well as, providing the awareness of the benefits of meteorology and hydrology for the economic well-being of the 16 CMO Member States. This is achieved through training, research, investigations, and the provision of related specialised services and advice.

2.02 In achieving its mandate, CIMH has established an affiliation with the University of the West Indises where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is also recognised by the World Meteorological Organisation (WMO) as: (i) the WMO regional training centre in the Caribbean for meteorology and hydrology and related disciplines; (ii) a regional instrument centre for the Caribbean; (iii) centre of excellence in satellite meteorology training; and (iv) the WMO regional climate centre (in demonstration phase) for the Caribbean.

2.03 In addition, CIMH is a repository for the climate data from CMO Member States. The institute is also an important Caribbean centre for research and development related to meteorology, hydrology, agro-meteorology and climate in the Caribbean. It is active in such areas of hydrological risk impacts forecasting and agricultural risks forecasting and has had strong collaborations with other regional institutions, national organisations in CMO Member States and the international community.

3. OBJECTIVES

3.01 The primary objective of this assignment is to implement the RASOR Platform to support scenario-based risk assessments and strengthen disaster risk reduction activities in the Caribbean.

4. SCOPE OF WORK

4.01 The activities envisioned to deliver the desired outputs will be supported by a consultancy. Specific duties and responsibilities of the Consultant include:

(a) strengthen CIMH's capacity to perform impact analysis through the RASOR platform in part through the development and application of damage and loss exceedance curves. It is expected that the training will be conducted in Italy by staff of the CIMA Research Foundation;

(b) ingestion of hazard, exposure and vulnerability data within the RASOR platform for one member state of the CMO. Hazard and exposure data housed at CIMH will be leveraged to support risk analyses through linkages with the Caribbean DEWETRA Platform; and

(c) implementation of the RASOR Platform workflow. It is expected that the platform will be applied for risk assessments in one Member State of the CMO. The hazards to be considered are strong wind and flood. Data from the CIMH four kilometres NWP currently ingested within the Caribbean DEWETRA Platform will be incorporated to support risk forecasts.

5. QUALIFICATIONS AND EXPERIENCE

5.01 The Consultant is required to have recognised credentials in Disaster Management, Risk Assessment, Hydro-meteorology or related disciplines. In addition, the Consultant must have:

(a) more than ten years of experience implementing risk based models;

(b) experience delivering impact analysis and risk management training; and

(c) experience working with developing countries.

6. DELIVERABLES

6.01 The Consultant will deliver:

(a) training material on impact analysis using the RASOR Platform and the development of damage and loss exceedance curves;

(b) a platform capable of computing hazard scenarios on built-up environment, infrastructure and producing a list of impact indicators that quantifies damage in terms of damage percentage, economic losses, amount of critical infrastructures and population affected; and

(c) a report on the RASOR Platform implementation and feasibility of expansion within the Caribbean.

7. DURATION

7.01. The assignment is expected to be completed within one year.

APPENDIX 2E

TECHNICAL ASSISTANCE - EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN
DRAFT TERMS OF REFERENCE

BUILDING THE CAPACITY OF YOUNG PROFESSIONALS IN CLIMATOLOGY, METEOROLOGY, HYDRO-METEOROLOGY AND RELATED FIELDS

1. INTRODUCTION

1.01 Recognising the importance of building a critical mass of young capable weather, climate and hydro-meteorological professionals to the region's resilience to climate change, increasing climate variability and extreme weather, Caribbean Institute for Meteorology and Hydrology (CIMH) initiated a young professionals programme in 2006 focused on students in the B.Sc. Programme in Meteorology at the University of the West Indies Cave Hill Campus. The programme subsequently expanded to include individuals from different disciplines including civil engineering, water resources management, climate science and remote sensing - all closely linked to the core programmes of CIMH. In recent years, the programme has been further expanded to include individuals from the social sciences in recognition of the fact that engaging persons in these disciplines is critical to building the core of boundary professional essential for understanding and better defining sectoral needs for and applications of weather, climate and hydro-meteorological information. Currently, the programme caters to young professionals in undergraduate and graduate programmes. The attachments lasts between three months to two years depending on the nature of the investigation.

1.02 Three-month attachments generally focus on exposing young professionals in undergraduate programmes to interesting and challenging problems with well constrained solution strategies that can be implemented in the requisite timeframe. The individuals are introduced to basic elements of research that builds their independent problem solving skills and expands their knowhow and knowledge base. The outputs from several of these attachments have been converted by CIMH into products and services used by the international community. For example, the CIMH Terminal Aerodrome Forecast software which is used by National Meteorological and Hydrological Services (NMHSs) in the Caribbean, has been translated into Spanish, and now used by NMHSs in Central and South America starting out as a summer attachment project. Several young professionals have also extended their projects into research projects for graduate degrees.

1.03 Longer attachments, usually on in the order of 1–2 years are undertaken by recent graduates seeking to extend their skillsets before either seeking employment or entering graduate programmes. These attachments focus on building prototypes of either new products or services. A good example is the implementation of the Wavewatch-3 software to build an operational high-resolution marine wave forecasting platform for the Caribbean Sea and adjacent oceans (http://ww3.cimh.edu.bb). The young professionals support their supervisors by conducting a significant portion of the basic work required to complete and operationalise the project. Several young professionals in recent years have supported investigations into boundary problems related to climate and (a) tourism, (b) energy and (c) agriculture. For example, one individual is currently investigating how geological hazards, when integrated with meteorological processes, can disrupt renewable energy production and civil aviation. Another individual is examining the application of virtual reality to meteorological and hydrological training and situational awareness and risk-informing the disaster management community. The results from these attachments have been quite promising. Several individuals have converted their opportunities into graduate research projects.

2. ABOUT THE CARIBBEAN INSTITUTE FOR METEOROLOGY AND HYDROLOGY

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2.02 In achieving its mandate, the CIMH has established an affiliation with the University of the West Indies where its primary responsibility is the delivery of the Bachelor of Science Programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is also recognised by the World Meteorological Organisation (WMO) as: (a) the WMO regional training centre in the Caribbean for meteorology and hydrology and related disciplines; (b) a regional instrument centre for the Caribbean; (c) centre of excellence in satellite meteorology training; and (d) the WMO regional climate centre (in demonstration phase) for the Caribbean.

2.03 In addition, the CIMH is a repository for the climate data from CMO Member States. The institute is also an important Caribbean centre for research and development related to meteorology, hydrology, agro-meteorology and climate in the Caribbean. It is active in such areas of hydrological risk impacts forecasting and agricultural risks forecasting and has had strong collaborations with other regional institutions, national organisations in CMO Member States and the international community.

3. OBJECTIVES

3.01 The primary objective of this activity is to continue the process of developing the next generation of regional professionals specialising in climatology, meteorology, hydrology and related disciplines through attachment and mentorship programmes focused on developing new innovative technologies and methodologies that address regional and global objectives.

4. SCOPE

4.01 CIMH will issue three two-year attachments contracts to suitably qualified university graduates. In addition, the CIMH will issue six three-month summer attachment contracts to suitably qualified university students. The individuals will be assigned mentors who will define their programme of work and guide their work activities.

4.02 Project assigned young professionals will support research and development activities of CIMH. Individuals on one-year contracts will receive exposure to cutting edge research and development through either participation in at least one regional/international conference or through a technical exchange with an international research and development organisation.

4.03 All participants will be expected to present the findings of their work at an internal CIMH seminar.

5. QUALIFICATIONS AND EXPERIENCE

5.01 Young professionals for the one-year contracts will have completed at least an undergraduate degree in either the Natural Sciences (Mathematics, Physics, Meteorology, Chemistry, Computer Science, Marine Science and Environmental Science) or the Social Sciences (Economics, Sociology and Business). Preference will be given to individuals with at least an Upper Second Class Honours Degree.

5.02 Individuals for the three month contracts should be enrolled in an undergraduate degree programme in either the Natural Sciences (Mathematics, Physics, Meteorology, Chemistry, Computer Science, Marine Science and Environmental Science) or the Social Sciences (Economics, Sociology and Business). Preference will be given to individuals with a 3.0/4.0 graduate point average.

6. DELIVERABLES

6.01 The following deliverables are envisioned:

(a) an Inception report outlining the potential projects interns will be invited to consider, anticipated risks during implementation;

(b) a Report on the names of selected interns and their respective work programmes;

(c) a Bi-monthlyProgress Reports; and

(d) a inal Project Report with two months following the end of the assignment.

7. DURATION AND WORKPLAN

7.01 The programme will be executed over a two year period (January 1, 2018 - December 31, 2019).

7.02 The tentative work plan for the programme includes:

(a) an Inception Report identifying potential areas of work to consider (January 15, 2018); six-month reports on the activities of the programme including the achievements of the young professionals during each period; and

(b) a Final Report highlighting the achievements of the programme and slide presentations of the work completed by each participant.

DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets/Indicators	Data Sources/ Means of Verification	Assumptions
Impact : Strengthened national and regional institutional capacity to plan for climate resilience and disaster risk management.			
Outcome Increased predictive capacity of national and regional institutions for weather and climate forecasting.	Improved local and regional marine and weather forecasting products and services made available to key stakeholders by CIMH and NMHSs by December 2019. Probabilistic forecasts of *Aedes aegypti* proliferation in the Caribbean used to inform mitigation measures for mosquito-borne viral infection by December 2019. Nine Caribbean young professionals increased their knowledge in climatology, meteorology and hydro-meteorology by December 2019.	(a) Project final report and technical publications by CIMH; (b) CDB supervision reports. (c) CARPHA and PAHO annual reports. (d) Survey or interviews with young professionals at the end of their internships.	National and regional agencies actively participate in the project.
Outputs (a) training in numerical weather prediction models, marine forecasting, use of DEWETRA Platform, and use of RASOR delivered. (b) feasibility study for CIMH to become a regional marine forecasting centre completed. (c) climate-based *Aedes aegypti* proliferation prediction model methodology developed and tested in a pilot BMC; and regional training delivered.	(a) 20 participants (disaggregated by sex) trained in numerical weather prediction models by May 2019. (b) 50 participants (disaggregated by sex) trained in marine forecasting by November 2018. (c) report on the feasibility of establishing a marine forecasting centre at CIMH finalised by August 2018. (d) 45 participants (disaggregated by sex) trained in the use of the DEWETRA Platform by August 2018. (e) three staff from CIMH trained in the use of RASOR Platform by May 2018. (f) pilot implementation of RASOR in Barbados and Haiti completed by March 2018.	(a) periodic progress report and technical publications by CIMH; and (b) CDB supervision reports.	Procurement and training schedules are executed in accordance with the project work plan.

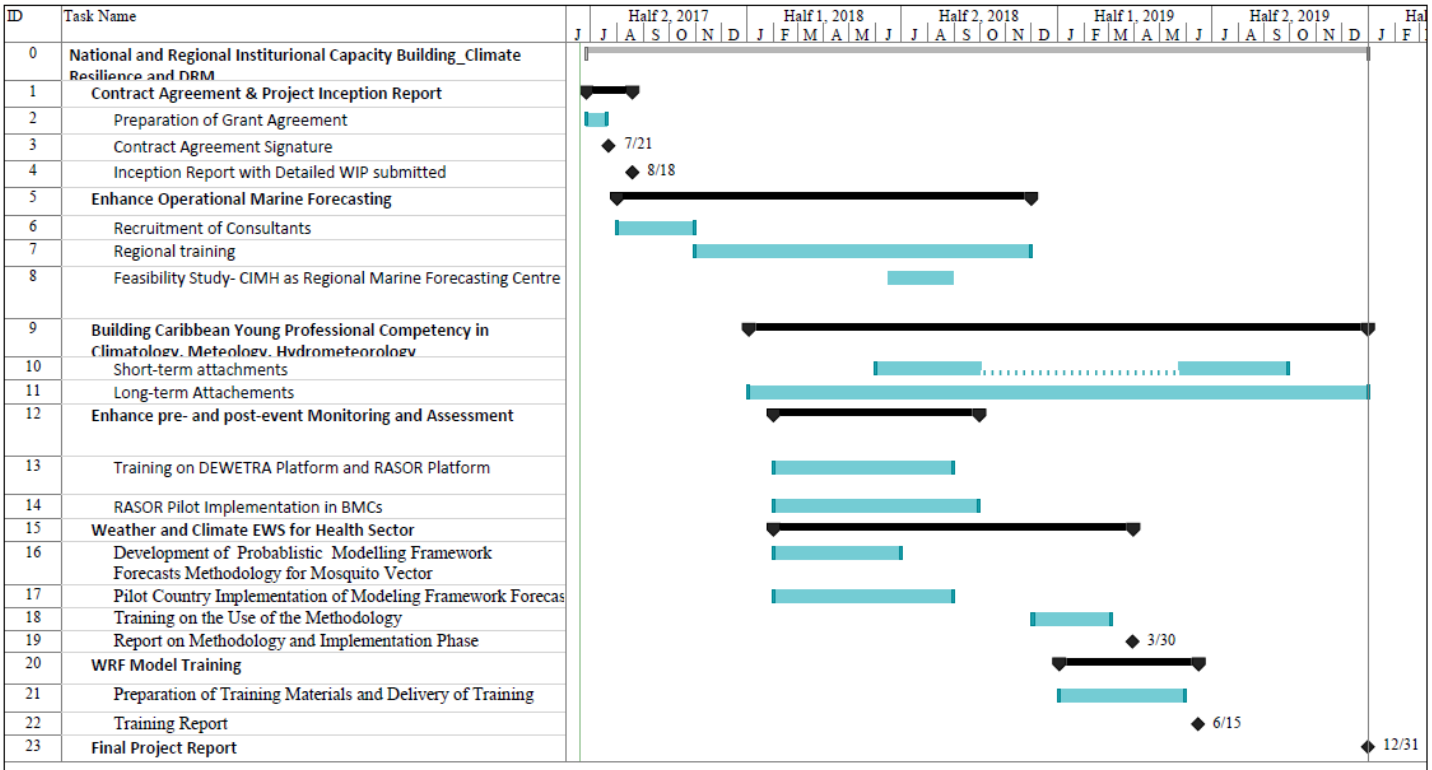
(d) training in climatology, meteorology and hydrometeorology completed.	(g) climate-based *Aedes aegypti* proliferation prediction model methodology developed and applied in two pilot BMCs by September 2018. (h) ten participants trained in the use of *Aedes aegypti* proliferation prediction model methodology by March 2019. (i) nine Caribbean young professionals trained in climatology, meteorology and hydrometeorology by December 2019.		

Costs and Financing:

Project Component	**Cost (EUR)**					
	Year 1		**Year 2**		**TOTAL CDB**	**TOTAL CIMH**
	CDB	**CIMH**	**CDB**	**CIMH**		
WRF Model Training	0	0	70,100	4,000	70,100	4,000
Operational Marine Forecasting in the Caribbean	185,250	6,000	32,450	8,000	217,700	14,000
Climate Early Warning for Mosquito vector, Aedes *aegypti*, Proliferation	72,850	6,000	45,600	4,000	118,450	10,000
Pre and Post-Event Monitoring and Assessment	0	0	168,100	59,000	168,100	59,000
Capacity Development of Young Caribbean Professionals in Climatology, Hydrology, Hydrometeorology and related Disciplines	64,200	45,000	64,200	45,000	128,400	90,000
Subtotal	322,300	57,000	380,450	120,000	702,750	177,000
Contingency (10%)	32,230	5,700	38,045	12,000	70,275	17,700
Total	**354,530**	**62,700**	**418,495**	**132,000**	**773,025**	**194,700**

APPENDIX 4

WORK IMPLEMENTATION SCHEDULE



Project: National and Regional
Date: Mon 6/19/17

Task	Inactive Summary	External Tasks
Split	Manual Task	External Milestone
Milestone	Duration-only	Deadline
Summary	Manual Summary Rollup	Progress
Project Summary	Manual Summary	Manual Progress
Inactive Task	Start-only	
Inactive Milestone	Finish-only	

APPENDIX 5

PERFORMANCE RATING SYSTEM

Criteria	Score	Justification
Relevance	4	The proposed project aligns with Result 2 "Improved local, national and regional resilience through strengthened early warning, national risk profiling and community-based DRR and CCA" of ACP-EU-CDB NDRM programme. The project is also consistent with CDB Sstrategic Objectives of (a) supporting inclusive and sustainable growth and development; and (b) promoting good governance; and CDB Corporate Priorities of (a) promoting environmental sustainability (climate change resilience, environmental management and DRM); and (b) strengthening evidence-based policy making.
Effectiveness	3	The project is designed to enhance climate resilience and DRM within BMCs and the Caribbean region. Its implementation will contribute to the achievements of the ACP-EU-CDB NDRM Result 2. Potential risks during project implementation and operation are identified and will be adequately addressed.
Efficiency	3	The expected costs of this project have been considered reasonable based on current professional rates and the expected deliverables. In addition, the activities and deliverables are expected to be achieved within time and budget.
Sustainability	3	The project emphasises on institutional strengthening of national (NMHS, NEMO, climate sensitive sectors) and regional (CIMH, CARPHA, CDEMA) partners for informed decisions with respect to extreme weather and climate events. The project will further support the development of competence of young climate and hydro-meteorological professionals to sustain the work being undertaken. The executing agency has been recognised for its work to deliver climate products and services to BMCs and has committed human resources to sustain the project.
Overall Score	**3.25**	**Satisfactory**

APPENDIX 6

GENDER MARKER

Project Cycle Stage	Criteria	Score
Analysis: Background	Sex-disaggregated data included in the background analysis, and/or baselines and indicators, or collection of sex-disaggregated data required in TOR. Socioeconomic analysis considers socioeconomic conditions or traditional role models that lead to disadvantages for males and females in participation in project activities or in the distribution of benefits.	1 1
Design: Project Proposal/ Definition/ Objective	TA interventions are designed, or will be identified as part of the project, that address gender disparities or enhance gender capacities. Project objective/outcome includes the enhancement of gender capacities, gender data collection, gender equality or the design of gender-responsive policies or guidelines.	0 1
Score:		3
Scoring Code		
Gender Specific (GS) or Gender Mainstreamed (GM): 3- 4 points **Marginally Mainstreamed (MM):** if 2 points. **NO:** if projects score 0-1, if NO give justification why or indicate Not Applicable		

APPENDIX 7

TECHNICAL ASSISTANCE- EXPANDED WEATHER AND CLIMATE FORECASTING AND INNOVATIVE PRODUCT AND SERVICE DEVELOPMENT AND DELIVERY IN THE CARIBBEAN

DUTIES AND RESPONSIBILITIES OF PROJECT COORDINATOR

1. The primary responsibility of the Project Coordinator (PC) is to give technical and administrative oversight for the project, coordinate the execution of all project activities to ensure quality of deliverables and that project objectives are achieved.

2. The duties and responsibilities of the PC will also include, but not limited to:

(a) managing the selection and engagement of consultants, and the procurement of goods and services;

(b) updating the Procurement Plan as necessary and at least annually;

(c) facilitating Caribbean Institute for Meteorology and Hydrology (CIMH) and key external stakeholder consultations;

(d) liaising with the Caribbean Development Bank (CDB) on all technical, administrative and financial aspects of the project;

(e) coordinating production of various communication and visibility materials, as required;

(f) reviewing technical documents related to the project and preparing and submitting progress reports to CDB; and

(g) executing any other tasks as assigned by CIMH to facilitate the successful completion of the project.

6. The Consultant must have recognised credentials (Masters degree or higher) in Environment Sciences, Climatology, Hydrology or related fields, and at seven years' experience in Project and Programme Management is required. The PC shall also possess: Project Management certification or demonstrated experience in Project Management; a good understanding of climate early warning systems; and strong communication skills.

7. The PC will be required to provide the following reports and deliverables to CDB:

(a) an Inception Report within two weeks of the signing of the Grant Agreement and a revised implementation schedule of all key activities;

(b) Bi-Monthly progress reports following the Inception Report until the end of the assignment; and

Project Completion Report within two months following the end of the assignment.

APPENDIX 8

TECHNICAL ASSISTANCE - STRENGTHENING NATIONAL AND REGIONAL INSTITUTIONAL CAPACITY TO PLAN FOR OPERATIONAL WEATHER AND CLIMATE FORECASTING

BUDGET

PROJECT COMPONENTS	COST (EUR)				
	YEAR 1		YEAR 2		
	CDB	CIMH	CDB	CIMH	TOTAL
Weather Research and Forecasting (WRF) Model Training			70,100	4,000	74,100
Operational Marine Forecasting in the Caribbean					
Introductory Course	60,000				60,000
Immediate Course	60,000				60,000
Advance Course	14,250				14,250
Satellite Marine Forecasting	51,000				51,000
Marine Forecasting Centre Consultancy		6,000	32,450	8,000	46,450
Climate Early Warning for Mosquito vector, *Aedes Aegypti*, Proliferation					
Kick-off Workshop	10,850				10,850
Analysis and Reporting Consultancy	62,000				62,000
Training Workshop and Consultation with CIMH		6,000	45,600	4,000	55,600
Pre and Post-Event Monitoring and Assessment					
Expanding Caribbean DEWETRA Platform Training & Support					
St. Kitts and Nevis Training Workshop (3 days)			7,200	3,000	10,200
Guyana Training Workshop (3 days)			7,200	3,000	10,200
Belize Training Workshop (3 days)			8,400	3,000	11,400
RASOR Consultation/Training at CIMA Foundation (Italy)			42,300		42,300
Pilot Implementation of RAZOR in Barbados and Haiti			103,000	50,000	153,000
Capacity Development of Young Caribbean Professionals in Climatology, Hydrology, Hydrometeorology and related Disciplines	64,200	45,000	64,200	45,000	218,400
Total	**322,300**	**57,000**	**380,450**	**120,000**	**879,750**
Contingency	**32,230**	**5,700**	**38,045**	**12,000**	**87,975**
Grand Total	**354,530**	**62,700**	**418,495**	**132,000**	**967,725**

APPENDIX 9

EUROPEAN UNION ELIGIBILITY RULES
AFRICAN CARIBBEAN PACIFIC – EUROPEAN UNION
NATURAL DISASTER RISK MANAGEMENT

PARTICIPATION IN PROCEDURES FOR THE AWARDING OF PROCUREMENT CONTRACTS OR GRANT CONTRACTS

1. Participation in procedures for the award of procurement contracts financed under the EU Contribution Agreement for the Implementation for the Action entitled: "Africa Caribbean Pacific – European – Caribbean Development Bank (ACP-EU-CDB) Natural Disaster Risk Management in CARIFORUM Countries" (ACP – EU NDRM Resources)", is open to international organisations and all natural persons who are nationals of, or legal persons who are established in, an eligible country.

2. Eligible countries[1] are deemed to be:

(a) Caribbean Development Bank member countries:

Anguilla, Antigua and Barbuda, Barbados, Belize, Brazil, British Virgin Islands, Canada, Cayman Islands, China, Columbia, Dominica, Germany, Grenada, Guyana, Haiti, Jamaica, Italy, Mexico, Montserrat, St Kitts and Nevis, Saint Lucia, St Vincent and the Grenadines, Suriname, The Bahamas, Trinidad and Tobago, Turks and Caicos Islands, the United Kingdom and Venezuela.

(b) Members of the "African, Caribbean and Pacific (ACP) Group of States"[2]:

Africa:

South Africa[3], Angola, Benin, Botswana, Burkina Faso, Burundi, Central African Republic, Cameroon, Cape Verde, Chad, Comoros Islands, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Equatorial Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Uganda, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, Sudan, Swaziland, Tanzania, Togo, Zambia and Zimbabwe.

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1 Note some countries may be eligible by virtue of more than one category

2 Cotonou Partnership Agreement of 23 June 2000 (as amended by the provisional application of Decision No 1/2000 of the ACP-EC Council of Ministers of 27 July 2000, Decision No 1/2000 of the ACP-EC customs cooperation committee of 18 October 2000, Decision No 1/2001 of the ACP-EC customs cooperation committee of 20 April 2001, Decision No 2/2001 of the ACP-EC customs cooperation committee of 20 April 2001, Decision No 3/2001 of the ACP-EC customs cooperation committee of 10 May 2001, Decision No 4/2001 of the ACP-EC customs cooperation committee of 27 June 2001, Decision No 5/2001 of the ACP-EC customs cooperation committee of 7 December 2001, Decision No 2/2002 of the ACP-EC customs cooperation committee of 28 October 2002, Decision No 1/2003 of the ACP-EC Council of Ministers of 16 may 2003, Council Decision (EC) of 19 December 2002, Decision No 1/2004 of the ACP-EC Council of Ministers of 6 may 2004, Decision No 2/2004 of the ACP - EC customs cooperation committee of 30 June 2004 and Decision No 4/2005 of the ACP-EC customs cooperation committee of 13 April 2005).

3 Natural and legal South African persons are eligible to participate in contracts financed by the 10th/11th EDF. However, the 10th/11th EDF does not finance contracts in South Africa.

Caribbean:

Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago.

Pacific:

Cook Islands, East Timor, Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Palau, Papua New Guinea, the Solomon Islands, Western Samoa, Tonga, Tuvalu, Vanuatu.

Overseas Countries and Territories:

Anguilla, Antarctic, Netherlands Antilles, Aruba, British Indian Ocean Territory, British Virgin Islands, Cayman Islands, Falkland Islands (Malvinas), French Polynesia, French Southern Territories, Greenland, Mayotte, Montserrat, New Caledonia, Pitcairn, Saint Helena, Saint Pierre and Miquelon, South Georgia and South Sandwich Islands, Turks and Caicos, Wallis and Futuna Islands.

(c) A Member State of the European Union:

Austria, Belgium, Bulgaria, Croatia, Czech republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.

An official candidate country of the European Union:

The Former Yugoslav Republic of Macedonia, Turkey, Iceland, Montenegro.

A Member State of the European Economic Area: Iceland, Lichtenstein, Norway.

(d) All natural persons who are nationals of, or legal persons who are established in, a Least Developed Country as defined by the United Nations:

Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Central African Republic, Chad, Comoros, Dem. Rep. Congo, Equatorial Guinea, Eritrea, Ethiopia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao PDR, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Sao Tome and Principe, Senegal, Sierra Leone, Djibouti, Solomon Islands, Somalia, South Sudan, Sudan, Tanzania, The Gambia, Timor-Leste, Togo, Tuvalu, Uganda, Vanuatu, Yemen, Rep. and Zambia.

(e) Participation in procedures for the award of procurement contracts or grants financed from the Facility shall be open to all natural persons who are nationals of, or legal persons established in, *any country other than those referred to in paragraph 1, where reciprocal access to external assistance has been established.* Reciprocal access in the Least Developed Countries as defined by the United Nations (UN) shall be automatically granted to the OECD/DAC members: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, Luxembourg,

Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States.

3. Services under a contract financed from the Facility may be provided by experts of any nationality, without prejudice to the qualitative and financial requirements set out in the Bank's procurement rules.

4. Supplies and materials purchased under a contract financed from the Facility must originate in a State that is eligible under paragraph 1. In this context, the definition of the concept of 'originating products' shall be assessed by reference to the Bank's prevailing procurement guidelines/procedures, and supplies originating in the EU shall include supplies originating in the Overseas Countries and Territories.

5. Whenever the Facility finances an operation implemented through an international organisation, participation in procedures for the award of procurement contracts or grants shall be open to all natural and legal persons who are eligible under paragraphs 1, care being taken to ensure equal treatment of all donors. The same rules apply for supplies and materials.

6. Whenever the Facility finances an operation implemented as part of a regional initiative, participation in procedures for the award of procurement contracts or grants shall be open to all natural and legal persons who are eligible under paragraph 1, and to all natural and legal persons from a country participating in the relevant initiative. The same rules apply for supplies and materials.

7. Whenever the Facility finances an operation co-financed with a third entity, participation in procedures for the award of procurement contracts or grants shall be open to all natural and legal persons eligible under paragraph 1, and to all persons eligible under the rules of the third entity. The same rules shall apply to supplies and materials.

Caveat: The Bank and EU eligibility requirements are subject to change by the Bank and the EU. The applicant is responsible for checking whether there have been any updates on the eligibility requirements, as well as the UN's list of Least Developed Countries.

APPENDIX 10

PROCUREMENT PLAN

I. General

1. Project information:

Country: Regional

Grant Recipient: Caribbean Institute for Meteorology and Hydrology (CIMH)

Project Name: Enhancing Weather and Climate Early Warning Systems and Impacts-Based Forecasting Platforms in the Caribbean

Project Executing Agency: CIMH

2. **Bank's Approval Date of the Procurement Plan**: July 20, 2017

3. **Period Covered By This Procurement Plan:** July 2017 – December 2019

II. Goods and Works and Non-Consulting Services

1. **Prior Review Threshold:** Procurement decision subject to prior review by the Bank as stated in Appendix 2 to the Guidelines for Procurement.

	Procurement Method	**Prior Review Threshold (USD)**	**Comments**
1.	Shopping: Goods/ Non-consulting Services	[redacted]	

2. **Reference to (if any) Project Operational/Procurement Manual**: Guidelines for Procurement (2006)

3 **Any Other Special Procurement Arrangements**: To comply with the requirements of the ACP-EU Finance Agreement the following is required:

(a) Financing shall be provided under ACP-EU-CDB NDRM in CARIFORUM Countries and thus eligibility shall include CDB member countries and be extended to reflect the applicable regulatory provisions of the EU.

4. **Procurement Packages with Methods and Time Schedule:**

1	2	3	4	5	6	7	8
Ref No.	**Contract (Description)**	**Estimated Cost (EUR)**	**Procurement Method**	**Prequal. (Yes/No)**	**Review by Bank (Prior/Post)**	**Expected Bid-Opening Date**	**Comments**
1	**WRF Model Training**						
	Airfare (18 persons)	[redacted]	Shopping	No	Post	December 2018	
	Google Cloud Service	[redacted]	Shopping	No	Post	December 2018	
2	**Operational Marine Forecasting in the Caribbean (5 Workshops)**						
	Airfare (60 persons)	[redacted]	Shopping	No	Post	October 2017	
	Venue and Catering (45 persons)	[redacted]	Shopping	No	Post	October 2017	
3	**Climate Early Warning Services for the Health Sector – Climate Early Warning for *Aedes aegypti* Proliferation**						
	Airfare (14 persons)	[redacted]	Shopping	No	Post	December 2017	
	Webinars	[redacted]	Shopping	No	Post	December 2017	
4	**Enhancing Pre and Post Event Monitoring and Assessment (3 Workshops)**						
	Airfare (12 persons)	[redacted]	Shopping	No	Post	December 2017	
	Venue and Catering	[redacted]	Shopping	No	Post	December 2017	
5.	**Capacity Development of Young Caribbean Professionals in Climatology, Hydrology, Hydro-Meterology and related Disciplines**						
	Airfare (12 persons)	[redacted]	Shopping	No	Post	December 2017	

III. Consulting Services

1 **Prior Review Threshold:**
Procurement decision subject to prior review by the Bank as stated in Appendix 1 to the Guidelines for the Selection and Engagement of Consultants.

	Selection Method	Prior Review Threshold (EUR)	Comments
1	ICS	[redacted]	
2	CQS	[redacted]	
3	QCBS	[redacted]	
4.	SSS	[redacted]	

2 **Reference to (if any) Project Operational/Procurement Manual**: Guidelines for Selection and Engagement of Consultants (October 2011).

3 **Any Other Special Procurement Arrangements**: To comply with the requirements of the ACP-EU Finance Agreement the following is required:

(a) Financing shall be provided under ACPEU-CDB NDRM in CARIFORUM Countries and thus eligibility shall include CDB member countries and be extended to reflect the applicable regulatory provisions of the EU.

(b) The International Centre on Environmental Monitoring "*Centro Internazionale in Monitoraggio Ambientale*" (CIMA) is coordinating the RASOR platform to perform multi-hazard risk analysis. The RASOR platform was successfully used in October 2016 to support modeling of the impact of Hurricane Matthew on the southern peninsula of Haiti. Therefore, given the continuation of its work on the coordination and use of the RASOR Platform and its exceptional experience and qualifications, in accordance with paragraph 3.9 of the aforementioned CDB Guidelines for the Selection and Engagement of Consultants, CIMA shall be single-sourced to strengthen CIMH's capacity to perform impact analysis through the RASOR platform.

4. **Procurement Packages with Methods and Time Schedule:**

1	2	3	4	5	6	7
Ref No.	**Assignment (Description)**	**Estimated Cost (EUR)**	**Selection Method**	**Review by Bank (Prior/Post**	**Expected Proposal Submission Date**	**Comments**
1.	Weather Research and Forecasting Model Training		CQS	Prior	October 2018	
2.	Marine Forecasting Centre Consultancy		QCBS	Prior	October 2017	
3.	Climate Early Warning for Mosquito Vector		CQS	Prior	October 2017	
4.	Enhancing Pre and Post Event Monitoring and Assessment-RASOR Platform		SSS	Prior	October 2017	
5.	Capacity Devlopment of Young Caribbean Professional (9 persons)		ICS	Prior	November 2017	

IV. Implementing Agency Procurement Capacity Building Activities with Time Schedule

1. In this section the agreed Capacity Building Activities are listed with time schedule.

No.	Expected Outcome/ Activity Description	Estimated Cost	Estimated Duration	Start Date	Comments
1	Increased Capacity of CIMH to undertake procurement in accordance with CDB Procurement Procedures Through CDB Online Procurement Training.	0	1 day	August 2017	
2	Launch Workshop-Technical Sessions on Procurement, Disbursements and Reporting.	0	1 day	August 2017	

V. Summary of Proposed Procurement Arrangements

Project Component	ACP-EU-CDB (EUR)									Total Cost (EUR)
	Primary	Secondary			Other					
	ICS	NCB	RCB	LIB	Shopping	SSS	ICS	QCBS	CQS	
1. Weather Research Forecasting Model Training	-	-	-	-	[redacted]	-	-	-	[redacted]	[redacted]
2. Operational Marine Forecasting in the Caribbean	-	-	-	-	[redacted]	-	-	[redacted]	-	[redacted]
3. Climate Early Warning for Mosquito Vector, *Aedes aegypti* Proliferation	-	-	-	-	[redacted]	-	-	-	[redacted]	[redacted]
4. Enhancing Pre and Post Event Monitoring and Assessment	-	-	-	-	[redacted]	[redacted]	-	-	-	[redacted]
5. Capacity Development of Young Caribbean Professional	-	-	-	-	[redacted]	-	[redacted]	-	-	[redacted]
Sub-Total	-	-	-	-	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
6. Per Diem	-	-	-	-	-	-	-	-	-	[redacted]
7. Contingencies	-	-	-	-	-	-	-	-	-	[redacted]
TOTAL	-	-	-	-	-	-	-	-	-	[redacted]

CQS - Consultant Quality Selection
DC - Direct Contracting
FA - Force Account
FBS - Fixed Budget Selection
ICB - International Competitive Bidding
LIB - Limited International Bidding
NCB - National Competitive Bidding
NBF - Non-Bank Financed
QCBS - Quality and Cost-Based Selection
RCB - Regional Competitive Bidding
ICS - Individual Consultant Selection

This information is withheld in accordance with one or more of the exceptions to disclosure under the Bank's Information Disclosure Policy.