The Programme for Building Regional Climate Capacity in the Caribbean (BRCCC Programme)
Component 4.1: Development of the Regional Climate Centre (RCC)
Technical Area III: Development of Seasonal Forecasting Capabilities to apply to Climate-Sensitive Sectors in the Caribbean

TERMS OF REFERENCE

CONSULTANCY FOR THE DEVELOPMENT OF
A HEALTH-CLIMATE SPATIO-TEMPORAL MODELLING FRAMEWORK FOR THE CARIBBEAN

The Caribbean Institute for Meteorology and Hydrology (CIMH) is looking for a Consultant team to:

1. Collaborate with a regional, inter-institutional, multi-disciplinary[1] team on research leading to the development of a health-climate spatio-temporal modelling framework for the Caribbean; and
2. Lead a capacity building exercise in health-climate spatio-temporal model development for regional and national representatives.

Please find enclosed the Terms of Reference (ToR) for the Consultancy assignment. The CIMH invites interested expert teams to submit their expression of interest covering the points outlined in the ToRs, accompanied by the following application documents:

- Curriculum Vitae (CV) of all team members;
- Letter of Motivation outlining how your team's experience, skills, qualifications and professional networks fit with the required deliverables (one page maximum); and
- Copies of relevant articles/reports/bulletins/outlooks via submission of published url links or PDF versions via e-mail attachments.

Deadline for Submission of Expression of Interest

Submissions in PDF format must be e-mailed to atrotman@cimh.edu.bb and copied to rmahon@cimh.edu.bb and scox@cimh.edu.bb with application ID "EWISACTS/Health". Submissions will be received until **Friday September 9th, 2016** up to and including **5:00PM EST**. All inquiries for information regarding this solicitation should be directed to the e-mail addresses above.

[1] Composed of health researchers and practitioners (CARPHA/PAHO), statisticians (University of the West Indies), specialists in geographic information systems (CIMH) and climatologists/meteorologists (CIMH).

1. Organization

The Caribbean Institute for Meteorology and Hydrology (CIMH)

2. Organizational Unit

Applied Meteorology and Climatology (AMC)

3. Application Identity Code:

EWISACTS/Health

4. Introduction

The Caribbean Institute for Meteorology and Hydrology (CIMH)

The Caribbean Institute for Meteorology and Hydrology (CIMH) is an Institution of the Caribbean Community (CARICOM) and the technical Organ of the Caribbean Meteorological Organization (CMO). The mandate of the CIMH is to assist in improving and developing the Meteorological and Hydrological Services, as well as, providing awareness of the benefits of Meteorology, Hydrology and Climatology for the economic well-being of the 16 CIMH Member States[2]. This is achieved through training, research, investigations, and the provision of related specialized services and advice.

Since April 2013, CIMH has been in the demonstration phase of becoming the World Meteorological Organization (WMO) Regional Climate Centre (RCC) for the Caribbean. WMO RCCs are Centres of Excellence that produce regional climate products and services including short-, medium- and long-range forecasts in support of regional and national climate information needs. The information produced and capacity developed by the CIMH enables CMO Member States to deliver better climate services to national and regional users.

The Building Regional Climate Capacity in the Caribbean Programme (BRCCC Programme)

The CIMH is currently implementing the 3 year United States Agency for International Development (USAID) funded Building Regional Climate Capacity in the Caribbean Programme (BRCCC Programme). This Programme is a regional cornerstone to the implementation of the Global Framework for Climate Services[3] (GFCS) in the Caribbean. The BRCCC Programme will increase the relevance and reach of the CIMH while developing, testing and disseminating new tools and information products directed at building the capacity of sectoral decision-makers and policymakers in the Caribbean to use climate early warning information. Programme

[2] These include: Anguilla, Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, and the Turks and Caicos Islands.

[3] The GFCS is a United Nations-led initiative spearheaded by the WMO to guide the development and application of science-based climate information and services in support of decision-making (WMO, 2011, 2014).

Component I - Technical Area III seeks to improve the range and use of climate-related products and services at the appropriate spatio-temporal scales for decision-makers in the health sector.

5. Background

Climate-sensitive diseases in Small Island States

Small island states are likely the countries most vulnerable to the impacts of climate variability and long-term climate change (Ebi et al 2006). Many small island states currently suffer high socio-economic burdens from climate-sensitive health outcomes, including morbidity and mortality from extreme events such as certain vector-, food- and waterborne diseases (Ebi et al 2006). The Caribbean region is no exception.

With impacts already evident, going forward, the Caribbean health sector will likely be further affected by the adverse effects of climate variability and change. This highlights the need for climate-sensitive sectors such as health to engage in climate risk management - "a systematic and coordinated process in which climate information is used to reduce the risks associated with climate variability and change, and to take advantage of opportunities, in order to improve the resilience of social, economic and environmental systems" (Martínez et al., 2012). The use of seasonal climate forecasts forms a first-hand approach to climate risk management as such forecasts provide early warning for potential impacting climate events within a few months following their issuance (Van Meerbeeck, Farrell, & Trotman, 2013).

The climate sensitivity of vector-borne diseases in the Caribbean

Climate variability, the primary expression of climate change, is one of the most important environmental problems affecting vector-borne diseases (Ortiz et. al, 2015). Vector-borne diseases such as yellow fever, dengue fever, chikungunya and Zika have important health burdens for Caribbean territories. A very conservative estimate for example, suggests that dengue costs the Caribbean about US$321 million annually[4]. Moreover, the Caribbean remains the area within the Americas with the highest cost per capita (International dollars $8.70) (Shepard, Coudeville, Halasa, Zambrano, & Dayan, 2011) and about 9,000 years of lost time due to ill health and premature deaths[5] as a result of dengue.

Yellow fever, dengue fever, Chikungunya and Zika share a common vector – the *Aedes* mosquito, more commonly the *Aedes aegypti* mosquito in the Caribbean – a disease vector that is climate sensitive. While climate is not the only factor that influences epidemic processes, climate accounts for some variation and is a significant factor that may create conditions that facilitate the development of vectors such as the *Aedes aegypti* mosquito. For example, tropical

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[4] 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.

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

and sub-tropical climate conditions allow the *Aedes aegypti* mosquito to thrive during warmer, wetter and more humid months (Ouma & Ogallo, 2015). Moreover, the distribution and abundance of this vector may be affected by even small changes in ambient temperature and precipitation (Ouma & Ogallo, 2015).

Despite research efforts worldwide, there are few studies addressing the use of information on climate variability for prevention and early warning of vector-borne infectious diseases (e.g. Ortiz et. al, 2015). In the Caribbean, significant prior research has already observed a link between past climate trends, increased mosquito incidence and dengue risk (Depradine & Lovell, 2004). For example, dengue occurrence 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 increases (Taylor et al, 2009). Although the prospect of producing different types of risk outlooks as part of an early warning model framework driven by real-time seasonal climate forecasts has recently been achieved in other parts of the world[6], the operational production of climate information for predicting increased *Aedes aegypti* populations remains an untapped opportunity to support climate resilience in the wider Caribbean.

6. Consultancy Aim and Objectives

In order to prepare for yellow fever, dengue fever, Chikungunya and Zika epidemics, early warning information systems, which take into account multiple risk factors, including climate, are needed. Since seasonal climate forecasts provide an opportunity to anticipate climate conditions conducive to these epidemics several months in advance, the operational use of climate information, including seasonal climate forecasts, as an input into a vector proliferation early warning system is now a priority for the Caribbean.

The timely production of health-specific climate forecasts will demand close collaboration between public health specialists, climate scientists, and statistical modellers to incorporate real-time seasonal climate forecasts, entomological and epidemiological data into a spatio-temporal model framework that is capable of modelling health-climate outcomes several months ahead. Under the BRCCC Programme, the CIMH has partnered with the Caribbean Public Health Agency (CARPHA), the Pan-American Health Organization (PAHO) and other regional and national stakeholders to develop health-specific seasonal forecasting products and capabilities in the Caribbean health sector[7].

The aim of this Consultancy is to work collaboratively with regional stakeholders to develop a modelling framework to provide spatio-temporal probabilistic forecasts of *Aedes aegypti*

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[6] For example, Lowe et al., 2014 developed a dengue risk outlook for Brazil while Ortiz et. al, 2015 developed an Aedes aegypti proliferation outlook in Cuba.

[7] This contributes to Outcome Area I: Established relationships between meteorologists/climatologists, scientists from other sectors and policymakers from across sectors.

proliferation. In doing so, the Consultant team will develop and/or modify statistical models for describing, simulating and predicting spatial patterns of *Aedes aegypti* populations associated with climate variability patterns. At a given point in time, and following the trend of the Caribbean Climate Outlook Forum (CariCOF)[8], the statistical models should provide an outlook of 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.

Within the framework of the BRCCC Programme, the objectives of the Consultancy are to:

1. Collaborate with a regional, inter-institutional, multi-disciplinary[9] team on research leading to the development of a health-climate spatio-temporal modelling framework for the Caribbean; and
2. Lead a capacity building exercise in health-climate spatio-temporal model development for regional and national representatives.

Ultimately, this Consultancy seeks to explore the potential use of climate information for *Aedes aegypti* proliferation early warning in the Caribbean and will use a participatory approach to translate investment in health-climate research into practice to improve national and regional health outcomes.

7. Consultant deliverables and indicative schedule

1.	An Inception Report (inclusive of data assessment results)	October 2016
2.	*Aedes aegypti* proliferation modelling framework	February 2017
4.	Capacity building webinar series	October 2016 - March 2017
5.	A Final Report	March 2017

8. Co-deliverables (Consultant and CIMH) and indicative schedule

1.	A co-developed publicity article for publication in the WMO's Climate Bulletin	March 2017

[8] The CariCOF convenes scientists (national, regional, and international) and sectoral decision-makers across the Caribbean to achieve four goals: (1) formulate and communicate seasonal rainfall outlooks; (2) identify information and capacity gaps; (3) facilitate research cooperation and data exchange; and (4) improve coordination within the Caribbean climate forecasting community.

[9] Composed of health researchers and practitioners (CARPHA/PAHO), statisticians (University of the West Indies), specialists in geographic information systems (CIMH) and climatologists/meteorologists (CIMH).

9. CIMH and partners inputs

- Background documents;
- Epidemiological data;
- Entomological data;
- Meteorological data; and
- Socioeconomic data.

10. Duration

The contract would be for 6 months and is expected to start in October 2016.

11. Reporting lines

The Consultant shall report directly to the Chief of Section, Applied Meteorology and Climatology (AMC) or his designate.

Review and feedback on Consultant outputs will be provided by CIMH and its partners. However, outputs will be approved by the CIMH.

12. Travel involved

A minimum of 11 days travel to Barbados for two (2) team members is anticipated during the consultancy to contribute to a 2-day Inception/Validation meeting and a 1 week research visit. All travel and travel costs will be covered and organized by the Consultant.

13. Eligibility

The ideal Consultant team will meet the following criteria:

- A multi-disciplinary research team attached to a reputable research institution;
- Advanced degree(s) (Master or Ph.D.);
- Track record of research in health-climate spatio-temporal modelling frameworks;
- Professional experience specifically related to developing health-climate operational products for tropical environments; and
- Demonstrable experience organizing and delivering remote trainings would be an advantage.

14. Confidentiality / Non-Disclosure

All non-public information of the CIMH and its partners, in any format, whether of a technical, business or other nature, including, without limitation, any information relating to its operations, plans, know-how, trade secrets, business affairs, customers or suppliers, any information provided by the CIMH and its partners that has been identified as being proprietary

and/or confidential or that by the surrounding circumstances ought to be treated as confidential or any specifications, engineering and other data, software drawings, sketches, blueprints and any other documents provided by the CIMH (or by any third party at the request of CIMH) to the bidder for the purposes of this expression of interest shall remain confidential and the bidder shall not use or copy them for any purpose other than the fulfillment of this expression of interest.

The successful bidder will be required to sign a confidentiality agreement instructing its employees to keep confidential the information concerning the business, its financial affairs, its relations with employees, and creditors, as well as any other information which may or may not be specifically classified as confidential. The obligations set out in the confidentiality agreement shall survive the expiration or termination of the contract.

15. Cost Incurred to Develop the Expression of Interest

The CIMH is not liable for any costs incurred by any Consultant prior to issuance of a contract. The CIMH will not be responsible for any expenses, including but not limited to travel, lodging or other out-of-pocket expenses of any provider prior to the execution of a written agreement for services in a form acceptable to the CIMH.

16. Evaluation Process

The expression of interest will be evaluated using the following criteria to short-list Consultant teams:

EVALUATION CRITERIA	IMPORTANCE
Research experience in health-climate spatio-temporal modelling techniques	30%
Experience developing relevant operational health-climate early warning information products	30%
Demonstrable complementary strengths of research team	30%
Demonstrable experience organizing and delivering remote trainings	10%

References

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Ebi, K. L., Lewis, N. D., & Corvalan, C. (2006). Climate variability and change and their potential health effects in small island states: information for adaptation planning in the health sector. *Environmental Health Perspectives*, 1957-1963.

Lowe, R., Barcellos, C., Coelho, C. A., Bailey, T. C., Coelho, G. E., Graham, R., . . . Stephenson, D. B. (2014). Dengue outlook for the World Cup in Brazil: an early warning model framework driven by real-time seasonal climate forecasts. *The Lancet Infectious Diseases, 14*(7), 619-626.

Martínez, R., Hemming, D., Malone, L., Bermudez, N., Cockfield, G., Mushtaq, S., . . . Zougmoré, R. (2012). *Improving Climate Risk Management at Local Level – Techniques, Case Studies, Good Practices and Guidelines for World Meteorological Organization Members*.

Ouma, G., & Ogallo, L. (2015). UNISDR Scientific and Technical Advisory Group Case Studies-2015. In U. N. I. S. f. D. R. Reduction (Ed.).

Shepard, D. S., Coudeville, L., Halasa, Y. A., Zambrano, B., & Dayan, G. H. (2011). Economic impact of dengue illness in the Americas. *The American journal of tropical medicine and hygiene, 84*(2), 200-207.

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)

Van Meerbeeck, C., Farrell, D., & Trotman, A. (2013). *Development of Seasonal Climate Forecasts to Risk-Inform the Water Resources Sector*. Paper presented at the 22nd Annual Caribbean Water and Waste Water Association Conference, Barbados.

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