**Appendix 2**

**TERMS OF REFERENCE**

**CONSULTANCY SERVICES FOR BUILDING THE CAPACITY OF YOUNG PROFESSIONALS IN CLIMATOLOGY, METEOROLOGY, HYDRO-METEOROLOGY AND RELATED FIELDS**

1. **Introduction**

Recognising the importance of building critical mass in weather, climate and hydro-meteorological professionals to the region's resilience to climate change, increasing climate variability and extreme weather, the 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 the 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 professional relationships that are essential for understanding and better defining sectoral needs for applications of weather, climate and hydro-meteorological information. Currently, the programme caters to young professionals in undergraduate and graduate programmes. The attachments last between three months to two years depending on the nature of the investigation.

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 the 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 started out as a summer attachment project. Several young professionals have also extended their projects into research projects for graduate degrees.

1. **About the Caribbean Institute for Meteorology and Hydrology**

The 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 the awareness of the benefits of Meteorology and Hydrology for the economic well-being of the CIMH member states. This is achieved through training, research, investigations, and the provision of related specialized services and advice”.

In achieving its mandate, the CIMH in 1973 established an affiliation with the University of the West Indies in which its primary responsibility is the delivery of the B.Sc. programme in Meteorology in the Faculty of Pure and Applied Sciences. The CIMH is recognized regionally and globally as:

* The World Meteorological Organization (WMO) Regional Training Centre for the Caribbean;
* A centre for applied research and development in meteorology, hydrology/water resources, climatology and related areas including disaster risk reduction and impacts forecasting;
* The WMO Regional Instrument Centre for the Caribbean;
* A WMO Centre of Excellence for Training in Satellite Meteorology;
* The WMO Regional Climate Centre (RCC) for the Caribbean;
* The Caribbean Centre for Climate and Environmental Simulations;
* The Climate Data Archive for CMO Member States;
* The Pan American Centre for the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS);

The CIMH has strong collaborations with other Regional Institutions, national organizations in CMO Member States and the international community. Since 2006, the CIMH has been providing internships opportunities to graduate and undergraduate students registered at regional and international universities. While the majority of internships have supported research and development in Earth and Atmospheric Sciences, in recent years the areas of focus have been expanded to include Social Sciences, Computer Science and Information Technology. Internships commonly range from 3-months to 1-year with the potential for an increase to two years. Many interns have converted their projects to publications and conference presentations as well as M.Sc. and PhD graduate research programmes.

**Position 1:** *Hydrology Intern* - To support the characterization of exposed assets in target areas along the west coast of Barbados.

1. **Scope of Work**

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 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.

The RASOR platform 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.

The RASOR Platform was recently used to support modelling 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 characterized 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.

The implementation of the RASOR platform for flood risk analysis requires the generation of a flood inundation field that drives the damage and loss calculations across the exposed assets. Simulated flooding depths and extents are used to estimate flood related damages and losses. These estimates require that the attributes of the exposed assets related to value and replacement cost be known and categorized. As part of the RASOR implementation in Holetown, Barbados, the CIMH categorized the building materials and usage within the target area using the RASOR taxonomy. Application of the relevant vulnerability databases and damage functions associated with the taxonomy supports the quantification of risk.

Property and replacement cost values are significantly high along the west coast of Barbados giving rise to extremely high-risk exposures. Further expansion of the RASOR platform will allow for the broader characterization of national risk and support the identification of appropriate risk transfer mechanisms.

The successful candidate will support the characterization of exposed assets in target areas along the west coast of Barbados. This information will be used to expand the application of the RASOR platform across Barbados.

1. **Deliverables**
2. Inventory of exposed buildings and usage characterized within the target area using the RASOR taxonomy
3. GIS layer with exposed building attributes in GIS format
4. Modification of DTM in target area using building footprints
5. **Qualifications**

Candidates applying for the position should have as a minimum be enrolled in BSc degree programmes in Geomatics, Geographic Information Systems, Surveying or related discipline.

Given the regional and interdisciplinary nature of CIMH’s work, the successful intern should also possess:

* Strong cultural and social IQ;
* Excellent written and oral communication skills;
* Familiarity with common GIS software packages;
* Familiarity with GPS hardware

1. **Duration**

The duration of the internship is three (3) months.

1. **Reporting**

The successful candidate will be required to submit monthly progress reports and a final report within two weeks following the completion of the assignment detailing the activities performed under the internship.

**Position 2:** *Meteorology Intern* – To support data mapping regarding the passage of Hurricane Maria over Dominica.

1. **Scope of Work**

The CIMH was able to collect a vast amount of data from four automatic weather stations (AWS), numerous rain gauges and several water level stations in Dominica before, during and immediately after the passage of Hurricane Maria. The data collection is unique in that is it comprehensive meteorological and hydrological data that is unique combination that CIMH houses and can take advantage of and will be very instructive in studying the effects of the storm on such a small island and may reveal dynamics of the storm in terms of storm wind and water damage.

The goal of the study is to compile the collected data from AWS, and other automatic and manual stations, data and personal accounts from the two Meteorological offices, pictures of the reconnaissance mission post episode and satellite data, to effectively replicate the devastating effects of the category 5 hurricane across the island of Dominica. There is the possibility of relating the weather event thresholds to damage observed during the storm. The research will involve model simulation of the event using the CIMH WRF ARW and NNM Models. The candidate will be tasked with hydro-meteorological data analysis, weather model simulation and verification. The candidate must present a paper and presentation on their findings.

1. **Deliverables**
2. Provide a database of archived data for the period weather and hydrometeorological data from Hurricane Maria
3. Have weekly meeting with the supervising meteorology, along with a bi weekly report; and
4. Prepare a written scientific paper and presentation on student summer project.
5. **Qualifications**

Candidates applying for the position should be exploring applications of Meteorology in:

* areas of Basic meteorology; at minimum a successful complete of Level 1 Meteorology courses;
* at minimum a 3.00 GPA;

Given the regional and interdisciplinary nature of CIMH’s work, the successful intern should also possess:

* Strong cultural and social IQ;
* Excellent written and oral communication skills;

1. **Duration**

The duration of the internship is three (3) months.

1. **Reporting**

The successful candidate will be required to submit monthly progress reports and a final report within two weeks following the completion of the assignment detailing the activities performed under the internship.