CCRIF SPC

The Caribbean Catastrophe Risk Insurance Facility

Understanding CCRIF

A Collection of Questions and Answers

March 2015

Understanding CCRIF

A Collection of Questions and Answers

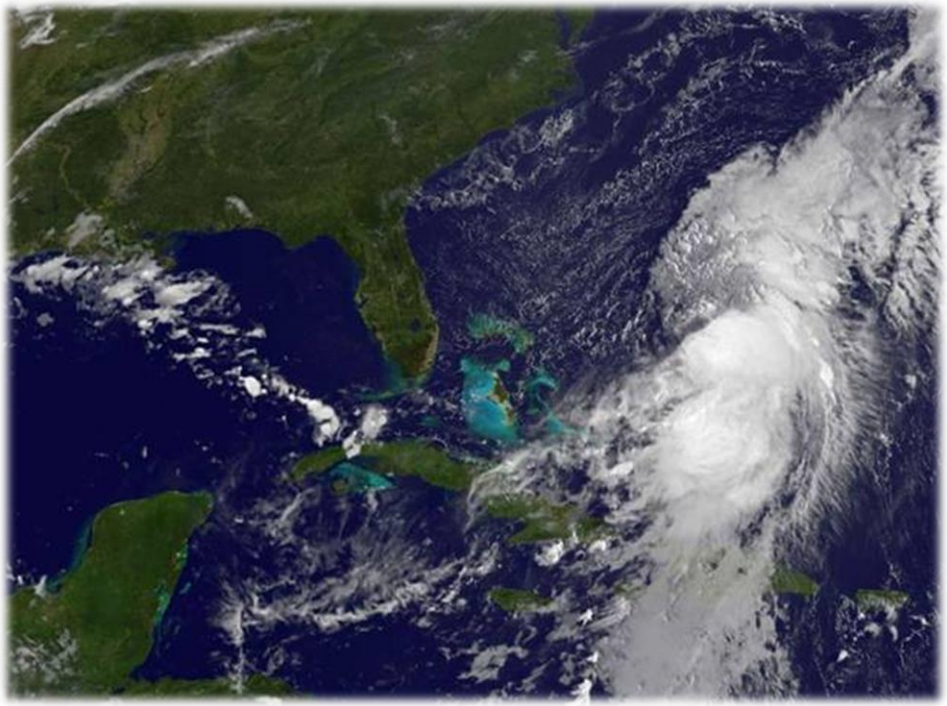
March 2015

Published by:
CCRIF SPC
103 South Church Street
Harbour Place, 1st Floor
P.O. Box 1087
Grand Cayman, KY1 – 1102
Cayman Islands

Acronyms

CARICOM	Caribbean Community
CBO	Community-Based Organisation
CCCCC	Caribbean Community Climate Change Centre
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster and Emergency Management Agency
CDM	Comprehensive Disaster Management
CEO	Chief Executive Officer
CIMH	Caribbean Institute of Meteorology and Hydrology
COSEFIN	Council of Ministers of Finance of Central America, Panama and the Dominican Republic
DRM	Disaster Risk Management
ECA	Economics of Climate Adaptation
EQ	Earthquake
GDP	Gross Domestic Product
IDB	Inter-American Development Bank
KAC	Kinetic Analysis Corporation
MDR	Mean Damage Ratio
MPRES	Multi-Peril Risk Evaluation System
NGO	Non-Governmental Organisation
NHC	National Hurricane Center
OECS	Organisation of Eastern Caribbean States
RTFS	Real-Time Hazard and Impact Forecasting System
SP	Segregated Portfolio
SPC	Segregated Portfolio Company
SRC	Seismic Research Centre (at the University of the West Indies)
TC	Tropical Cyclone
TRMM	Tropical Rainfall Measurement Mission
NASA	US National Aeronautics and Space Agency
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
US	United States
USGS	United States Geological Survey
UWI	University of the West Indies
XSR	Excess Rainfall

In this Book

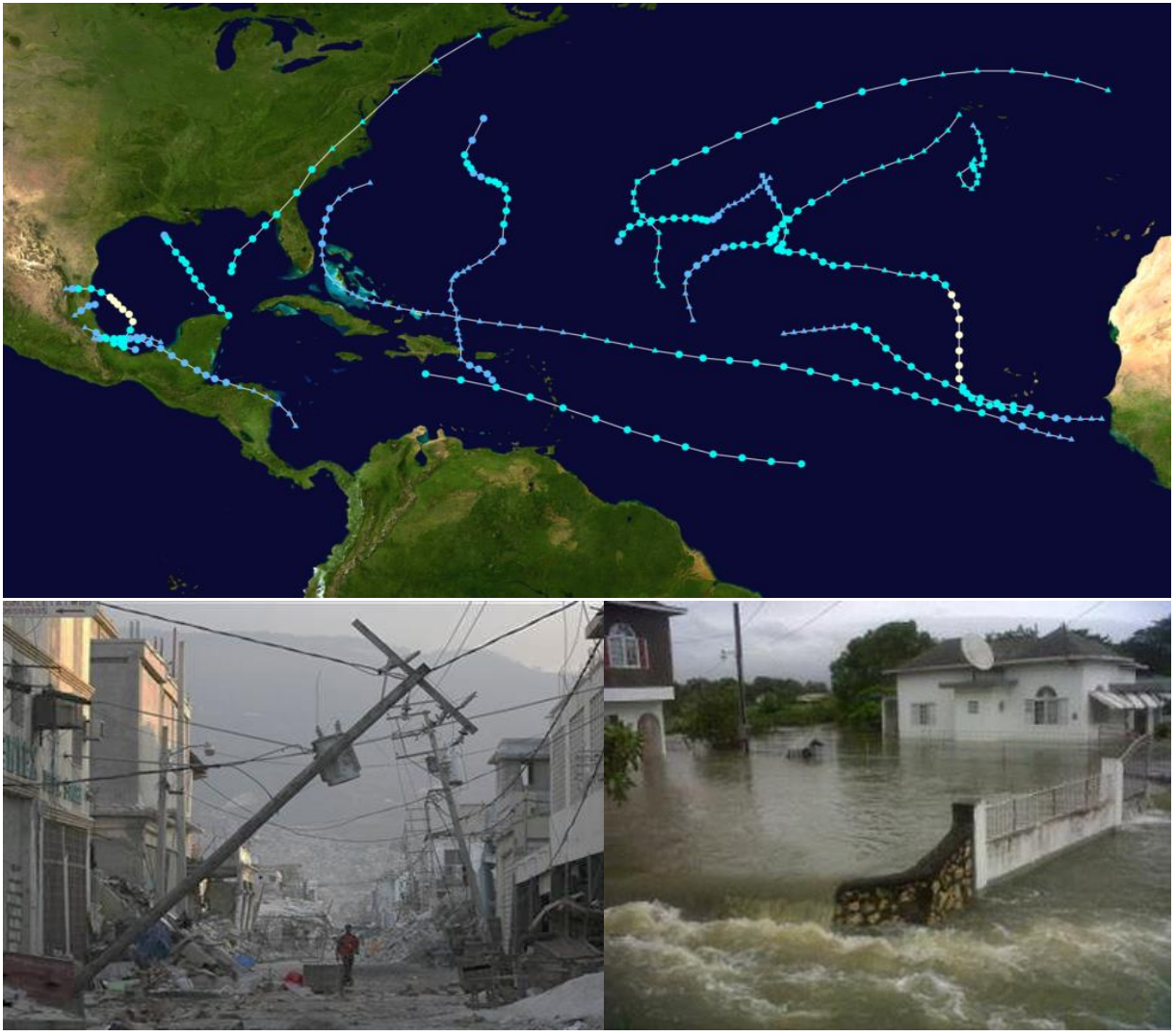


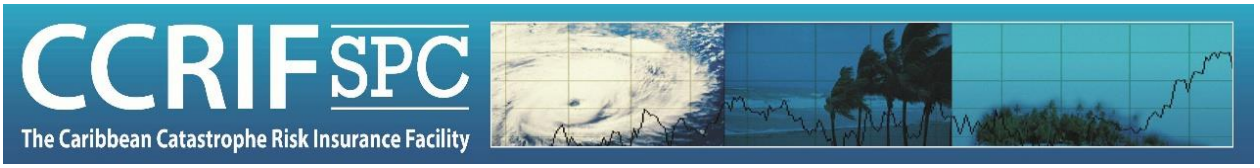
About this Book

CCRIF SPC (formerly the Caribbean Catastrophe Risk Insurance Facility) is a not-for-profit risk pooling facility, owned, operated and registered in the Caribbean for Caribbean governments. It offers parametric insurance designed to limit the financial impact of catastrophic tropical cyclones, earthquakes and excess rainfall events on Caribbean governments by quickly providing short-term liquidity when a policy is triggered. It is the world's first regional risk-pooling fund issuing parametric insurance and, as such, gives its member governments the opportunity to purchase natural catastrophe coverage at a price substantially below what they would be able to obtain through a non-pooled arrangement. CCRIF expects to provide similar coverage to Central American governments soon.

This book provides a collection of questions and answers that provide a comprehensive overview of CCRIF and its products and services as well as its role within the wider context of disaster risk management. It is an update to two earlier publications, "Understanding CCRIF – Answers to Frequently Asked Questions" (2013) and "A Guide to Understanding CCRIF – A Collection of Questions and Answers" (2010).

Additional information can be found on the CCRIF website – www.ccrif.org.





CCRIF and its Products

Q. What is CCRIF SPC?

A. CCRIF SPC is a not-for-profit risk pooling facility, owned, operated and registered in the Caribbean for Caribbean governments. It offers parametric insurance designed to limit the financial impact of catastrophic tropical cyclones, earthquakes and excess rainfall events on Caribbean governments by quickly providing short-term liquidity when a policy is triggered. It is the world's first regional risk-pooling fund issuing parametric insurance and, as such, gives its member governments the opportunity to purchase natural catastrophe coverage at a price substantially below what they would be able to obtain through a non-pooled arrangement. CCRIF expects to provide similar coverage to Central American governments soon.

Q. What is the relationship between CCRIF SPC and the Caribbean Catastrophe Risk Insurance Facility?

A. CCRIF SPC is the new name for the Caribbean Catastrophe Risk Insurance Facility. The Caribbean Catastrophe Risk Insurance Facility was formed in 2007 to provide parametric insurance for hurricanes and earthquakes to Caribbean governments. In 2014, the facility was restructured into a segregated portfolio company (SPC) to facilitate offering new products and expansion into new geographic areas. The new structure, in which products are offered through a number of segregated portfolios, allows for total segregation of risk but still provides opportunities to share operational functions and costs and to maximise the benefits of diversification. The function and purpose of CCRIF SPC is the same as the original Caribbean Catastrophe Risk Insurance Facility.

Q. What products does CCRIF offer?

A. CCRIF SPC offers Earthquake (EQ), Tropical Cyclone (TC) and Excess Rainfall (XSR) policies to Caribbean governments and will be offering Loan Portfolio Cover (LPC) policies to financial institutions in Caribbean countries as well as EQ and TC policies to Central American governments.

CCRIF provides or will provide these products through the following segregated portfolios (SPs):

- CCRIF SPC on behalf of Caribbean EQ-TC SP – providing Earthquake and Tropical Cyclone policies for Caribbean governments
- CCRIF SPC on behalf of Caribbean XSR SP – providing Excess Rainfall policies for Caribbean governments
- CCRIF SPC on behalf of Loan Portfolio Cover SP – to provide Loan Portfolio Cover policies for financial institutions in Caribbean countries
- CCRIF SPC on behalf of Central America SP – to provide Earthquake and Tropical Cyclone policies for Central American governments

Q. What is the difference between the Tropical Cyclone product and the Excess Rainfall product?

A. The Tropical Cyclone (TC) product is linked to wind and storm surge damage in a defined tropical cyclone. Rainfall is not covered by TC policies. The Excess Rainfall (XSR) product is linked to damage from rainfall and an XSR policy can be triggered if rainfall thresholds are met due to a tropical cyclone or to non-cyclonic systems such as trough systems. The TC and XSR products operate independently and if both policies are triggered by a given tropical cyclone then payouts on both policies would be due.

Q. Is CCRIF considering providing any new insurance products?

A. CCRIF is always seeking to meet the needs of its current and potential future member countries. Possible areas that CCRIF may consider providing coverage for in the next few years include drought and the agriculture sector.

Formation of CCRIF

Q. Why was CCRIF formed?

A. The CCRIF idea was prompted by the damage wrought by Hurricane Ivan in 2004. Following the passage of Ivan, the Caribbean Community (CARICOM) Heads of Government held an emergency meeting to discuss critical issues surrounding the need for the provision of catastrophe risk insurance for its members. Consequently, CARICOM resolved to take action and approached the World Bank for assistance to design and implement a cost-effective risk transfer programme for member governments. This marked the beginning of what would become the Caribbean Catastrophe Risk Insurance Facility.

Q. What is the purpose of CCRIF?

A. CCRIF was created in 2007 out of the recognition that natural catastrophes impose a significant burden on the financial ability of states to function after a disaster due to an unavailability of liquidity. The facility was originally structured as an insurance instrument to provide coverage similar to business interruption insurance in the event of losses from tropical cyclones or earthquakes. In 2013 CCRIF began offering coverage for excess rainfall as well.

Similar to a mutual insurance company, CCRIF is operated on behalf of 16 current participating states in the Caribbean, each of which pays an annual premium directly related to the amount of risk each transfers to CCRIF and purchases coverage up to a limit of approximately US$100 million for each insured hazard (tropical cyclones, earthquakes or excess rainfall events). By pooling these catastrophe risks into a single diversified portfolio, capital needs for paying claims are significantly lowered (see Figure 1). This in turn leads to a pricing reduction of about half of what it would cost if countries were to purchase identical coverage individually compared with buying the coverage from CCRIF.

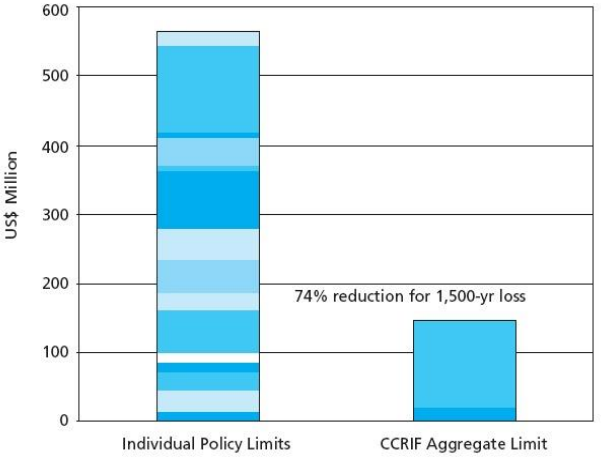


Figure 1: Insurance Costs

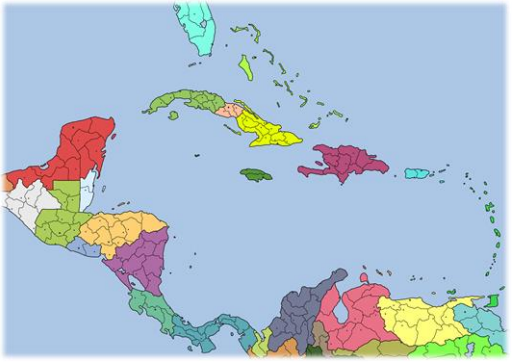
CCRIF therefore helps to mitigate the short-term cash flow problems small developing economies suffer after major natural disasters. A critical challenge is often the need for short-term liquidity to maintain essential government services until additional resources become available. CCRIF represents a cost-effective way

to pre-finance short-term liquidity to begin recovery efforts for an individual government after a catastrophic event, thereby filling the gap between immediate response aid and long-term redevelopment.

CCRIF Membership

Q. Who are CCRIF member countries?

A. Sixteen governments have been members of CCRIF since its inception in 2007: Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts & Nevis, Saint Lucia, St. Vincent & the Grenadines, Trinidad & Tobago and Turks & Caicos Islands.



Soon, CCRIF is expected to expand its membership to include countries in Central America through a partnership with COSEFIN – the Council of Ministers of Finance of Central America, Panama and the Dominican Republic. Also CCRIF is always exploring opportunities to include other Caribbean countries.

Q. How will expansion into Central America affect the Caribbean members?

A. Central American states will partner with CCRIF through a segregated-cell approach. Central American and Caribbean states will be grouped into legally separated pools of risk (two segregated portfolios) allowing for separation of risk management operations for Central American and current CCRIF countries (e.g. pricing, policy format) but enabling a bundled access to the reinsurance market.

Collaboration with new countries could provide important premium reduction benefits to existing CCRIF members due to the increased size of the CCRIF portfolio and increased access to the capital markets. Both Caribbean and Central American countries could benefit from additional savings if these countries approach the reinsurance market and capital markets through CCRIF together rather than independently.

The risk to current members of allowing Central American countries to join is minimal. The Central America segregated portfolio will pool the tropical cyclone and earthquake risk of participating Central American countries. The segregation of the portfolio makes it possible for current Caribbean members to keep their accumulated capital reserves legally separate from the new members' capital reserves and risk.

CCRIF Ownership and Governance

Q. How is CCRIF governed?

A. CCRIF is governed by a Board of Directors which is responsible for the approval and oversight of all policies related to the administration and operations of the Facility. The Board comprises no more than five members, including one representative for donors to the Multi-Donor Trust Fund[1] who are not participants in CCRIF's insurance programme, and is nominated by the Caribbean Development Bank (CDB); one representative for member countries that is nominated by CARICOM; two independent directors, appointed jointly by CDB and CARICOM for their insurance and financial expertise; and a Chairperson, selected by the other four directors.

[1] The Multi-Donor Trust Fund was created to support the establishment and operation of CCRIF.

A Chief Executive Officer (CEO) has overall management and administrative responsibility for the operation of CCRIF and for the performance of the Facility and its service providers. The CEO is supported by a Chief Operations Officer who is responsible for overseeing and ensuring the effectiveness and efficiency of CCRIF's day-to-day operations.

CCRIF is supported by a network of service providers that cover the areas of risk management, risk modelling, captive management, reinsurance, reinsurance brokerage, asset management, technical assistance, corporate communications and information technology.

CCRIF's organisational structure is shown in Figure 2.

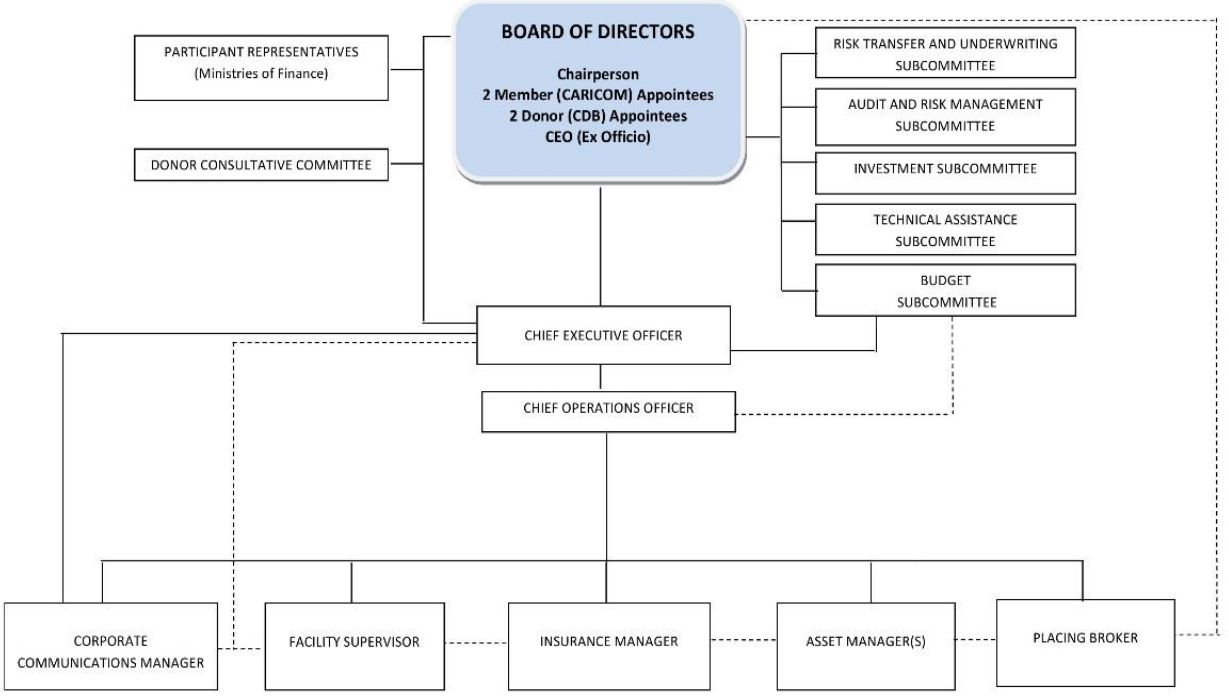


Figure 2: CCRIF Organisational Structure

Q. What role do member governments play in the governance of CCRIF?

A. One member of the Board of Directors, nominated by CARICOM, has the specific responsibility for representing the interests of the member countries. Also, member governments are directly consulted through the Ministries of Finance.

Q. How is CCRIF funded?

A. CCRIF was developed under the technical leadership of the World Bank and with a grant from the Government of Japan. It was initially capitalised through contributions to a Multi-Donor Trust Fund by the Government of Canada, the European Union, the World Bank, the governments of the UK and France, the Caribbean Development Bank and the governments of Ireland and Bermuda, as well as through membership fees paid by participating governments.

Q. How is the financial stability of CCRIF sustained?

A. CCRIF combines the benefits of pooled reserves from participating countries with the financial capacity of the international financial markets. It retains some of the risk transferred by the participating countries and transfers the remainder of the risk to reinsurance markets.

This structure results in a particularly efficient risk financing instrument that provides participating countries with insurance policies at the minimum price possible. Countries obtain coverage at approximately half the price they would pay if they approached the reinsurance industry on their own. For CCRIF policies, each country pays a premium directly related to the amount of risk it transfers to CCRIF. Pooling countries' risks reduces costs because multiple catastrophic events are highly unlikely to affect multiple states in a given year. For example, the likelihood of a severe hurricane impacting one country may be 5 per cent every year, but the

likelihood of three severe hurricanes impacting three different countries is likely much lower.

CCRIF is capitalised significantly above established national benchmarks for catastrophe insurers. Specific information about CCRIF's financial performance each year can be found in the Annual Reports, which are available on the CCRIF website.

Q. What is CCRIF's Strategic Framework?

A. CCRIF's Vision, Mission and Strategic Objectives are shown in Figure 3.

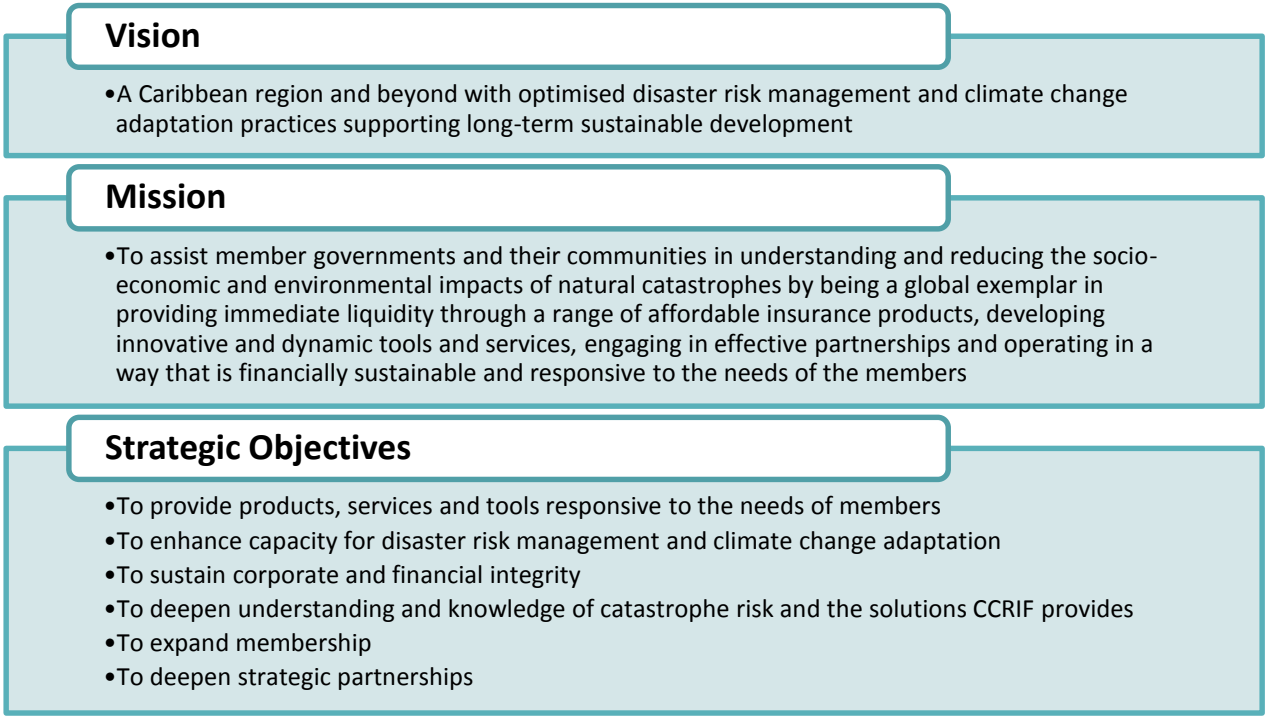
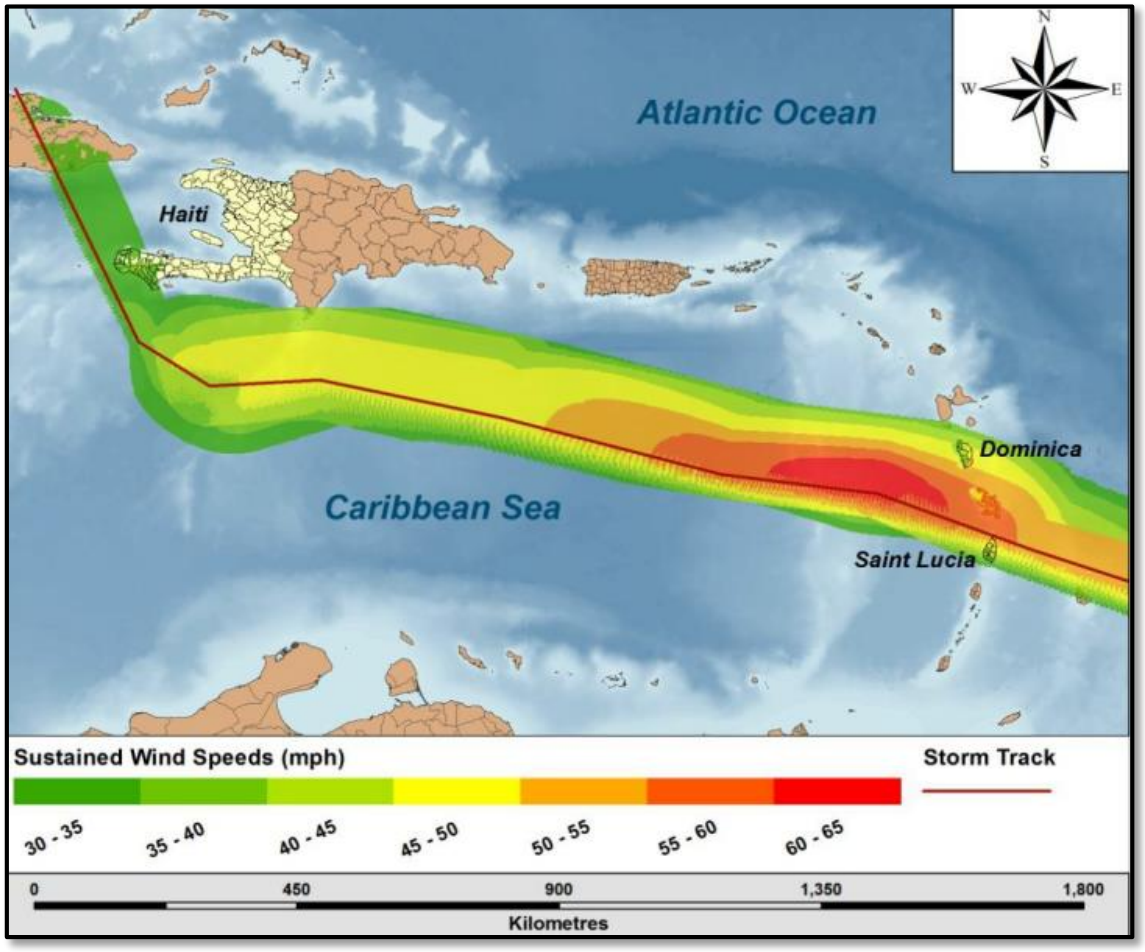


Figure 3: CCRIF's Strategic Framework


Atlantic Ocean
Haiti
Caribbean Sea
Dominica
Saint Lucia
N
W
E
S
Sustained Wind Speeds (mph)
30 - 35
35 - 40
40 - 45
45 - 50
50 - 55
55 - 60
60 - 65
Storm Track
0
450
900
1,350
1,800
Kilometres

Parametric Insurance

Q. What is parametric insurance?

A. Parametric insurance products are insurance contracts that make payments based on the intensity of an event (for example, hurricane wind speed, earthquake intensity, volume of rainfall) and the amount of loss calculated in a pre-agreed model caused by these events. Therefore payouts can be made very quickly after a hazard event. This is different from traditional insurance settlements that require an on-the-ground assessment of individual losses after an event before a payment can be made.

Q. Why was CCRIF designed to offer parametric insurance?

A. The main reasons CCRIF was designed to offer parametric insurance policies are as follows:

- Parametric insurance is generally less expensive than an equivalent indemnity insurance product.
- Payouts can be calculated and made very quickly because loss adjusters do not have to be relied on to estimate damage after a catastrophe event, which can take months or years.
- Governments do not have to provide detailed asset values and other information prior to the insurance programme commencing, and have just one form to sign during the entire claims process.
- Calculation of payouts is totally objective, based on a few simple input parameters published widely in the public domain from the globally-mandated bodies responsible for estimating those particular parameters, and a set of formulae which form part of the policy. The cost of insurance can be immediately related to the probability of an event, and the payout is independent of any mitigation efforts put in place after the policy is issued.

- The risk, which drives policy pricing, is uniformly defined (i.e. there is no subjectivity in the definition of the risk).

Q. Are there any disadvantages to parametric insurance?

A. Despite the many benefits to parametric insurance, parametric products are exposed to basis risk, *i.e.,* the possibility that a payout based on calculated losses may be higher or lower than actual losses on the ground. Although this is a significant challenge in terms of the development of a parametric instrument, careful design of input parameters and the loss model as undertaken by CCRIF helps reduce the basis risk.

The CCRIF Catastrophe Risk Model

Q. What are the elements of the CCRIF catastrophe risk model?

A. In undertaking the development of the CCRIF parametric insurance coverage, significant investment went into developing the underlying catastrophe risk model. Catastrophe risk models are essential tools in assessing the risk associated with catastrophe events. For the most part, they are based on robust datasets containing:

- A hazard module
- An exposure module
- A vulnerability module
- A damage module
- A loss module

Figure 4 illustrates the generic Hazard and Loss Modelling Framework employed by CCRIF.

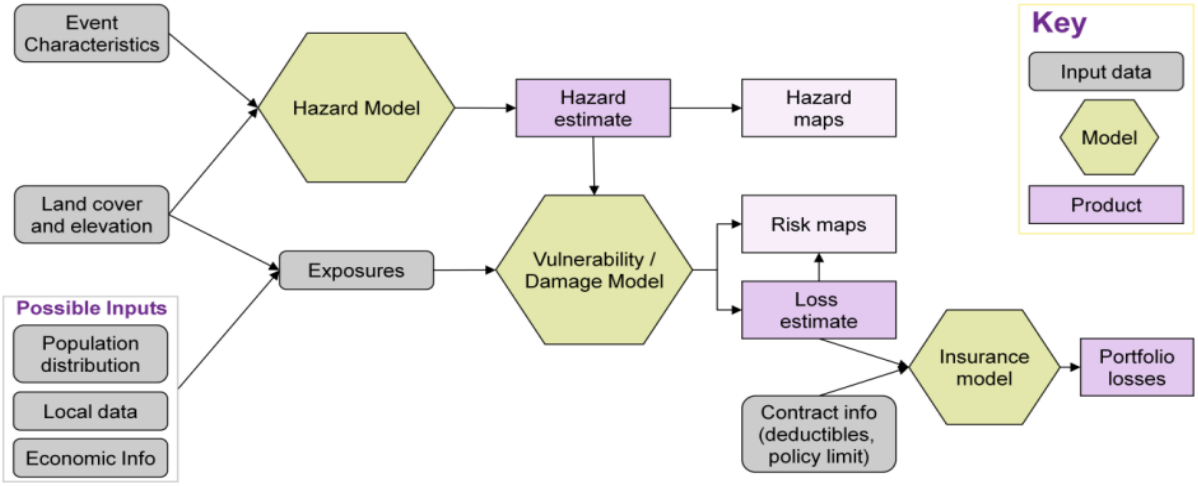


Figure 4: Hazard and Loss Modelling Generic Framework

The CCRIF model is no different, with the modules all developed within the context of the particular hazards of relevance to the client countries, these being tropical cyclones, earthquakes and excess rainfall.

The model for tropical cyclones and earthquakes is based on the Multi-Peril Risk Evaluation System (MPRES). This system, was developed for CCRIF and is supported by Kinetic Analysis Corporation (KAC), a risk modelling company with strong roots in the Caribbean. The MPRES can handle multiple hazards and hazard assessment methodologies, can accommodate a variety of input/output formats and detailed exposure classifications, and produces accurate loss estimates with known statistical uncertainty. The Caribbean Rainfall model, developed by KAC and Swiss Re, is used to calculate rainfall event loss.

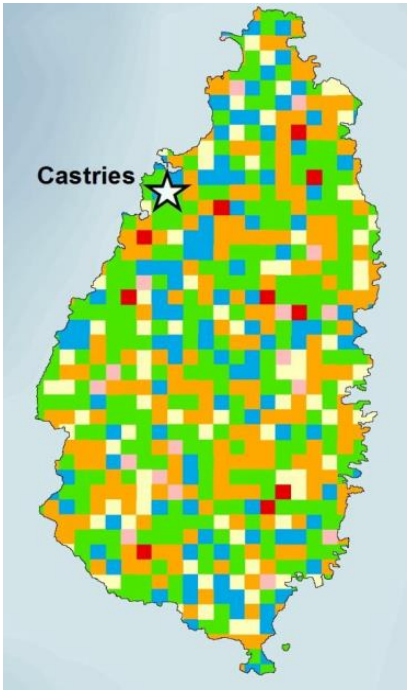
Hazard module Within the CCRIF model for tropical cyclones and earthquakes, the hazard module defines the frequency and severity of a hurricane or earthquake at a specific location. This is done by analysing the historical frequencies of the peril and

reviewing scientific studies on the severities and frequencies in the region of interest. Using these historic data, simulated event sets are generated which define the frequency and severity of thousands of simulated cyclone or earthquake events in terms of their tracks/locations/ intensities.

This hazard module then calculates the hazard intensity at each location for each event in the simulated set. This is done by modelling the attenuation/degradation of the hazard intensity from its source location to the site under consideration and evaluates the propensity of local site conditions to either amplify or reduce the impact.

Exposure Module In developing the exposure module, the exposure values of "assets at risk" are estimated from available secondary data sources (including economic, demographic and satellite data) and from the population distribution. This "proxy" approach is used due to limitations in availability of site-specific asset data. Based on tested algorithms, the module computes the value of different asset types for each 1 x 1 km grid square across the entire country in question. The exposure database is designed to provide acceptable estimates for losses to physical assets from hydrometeorological and geophysical hazards.

Vulnerability/damage module In terms of the vulnerability module, the starting point is to quantify the damage caused to each asset class by the intensity of a given event at a site. Estimation of damage is measured in terms of a mean damage ratio



Saint Lucia's exposure distribution. Each 1 x 1 km square shows the % of the country's total exposure in that area. Red squares show the highest exposure and pale yellow the lowest.

(MDR). The MDR is defined as the repair cost divided by replacement cost of the structure. The curve that relates the MDR to the hazard (earthquake shaking, wind or storm surge inundation, or excess rainfall) intensity is called a vulnerability function. Each asset class has a different vulnerability function for each hazard.

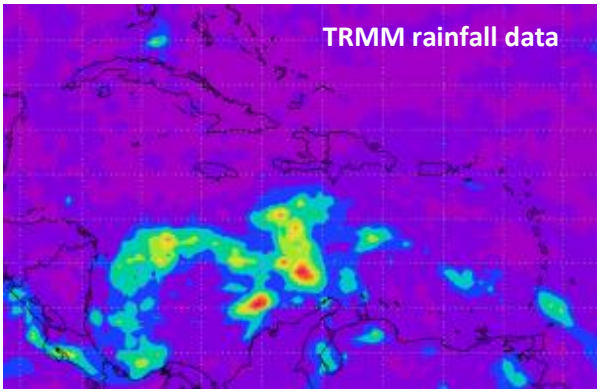
Loss module To calculate the losses, the damage ratio derived in the vulnerability module is translated into dollar loss by multiplying the damage ratio by the value at risk. This is done for each asset class in each grid cell. Losses are then aggregated as required (e.g. at the administrative or national level). Government assets or assets that are likely to be financed with government resources can be isolated and an assessment of financial needs for reconstruction calculated.

Q. Where does CCRIF get the input data used to determine losses for hurricanes, earthquake and excess rainfall?

A. CCRIF uses National Hurricane Center (NHC) data to determine loss for hurricanes, United States Geological Survey (USGS) information for earthquake loss. Currently, to determine loss for excess rainfall, CCRIF uses satellite data from the Tropical Rainfall Measurement Mission (TRMM), a research initiative undertaken by the US National Aeronautics and Space Agency (NASA) and the Japan Aerospace Exploration Agency. However, the TRMM mission will be coming to the end of its life in early 2016 and will not be available for use in the CCRIF model. Therefore CCRIF will be using a modelled precipitation approach which allows for the use of multiple input data sources, including data from other satellites.

Q. What is the model used for Excess Rainfall?

A. The current XSR model was developed for CCRIF by Kinetic Analysis Corporation (KAC) and Swiss Re. It is based on data from the Tropical Rainfall Measurement Mission (TRMM), which provides a satellite-based estimate of aggregate rainfall at quarter-degree (~25 km) resolution every 3 hours.

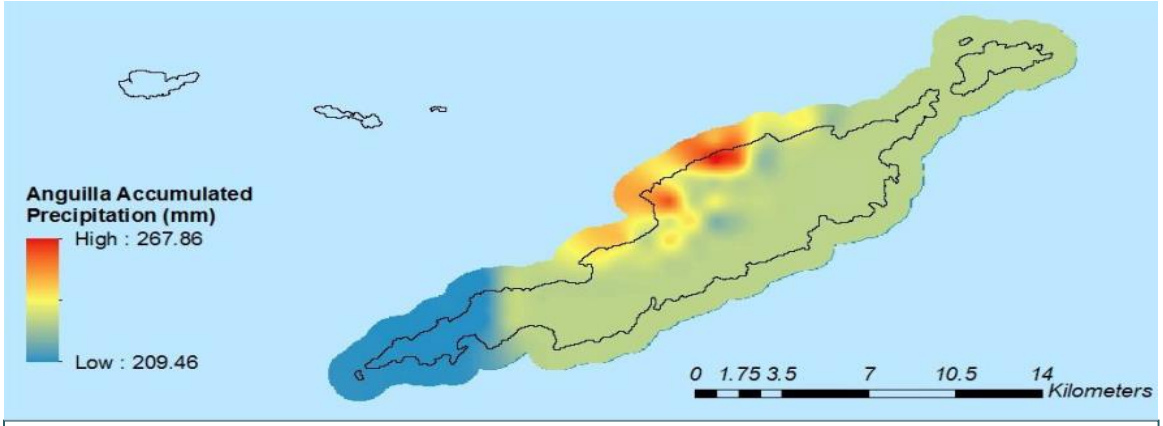


Using TRMM rainfall data, KAC produces enhanced rainfall estimates, or iTRMM ("improved" TRMM). iTRMM takes into account geographic details (topography) and is better than TRMM in capturing short, intense rainfall events.

The rainfall model will be changing for the 2015/2016 policies because of the termination of the TRMM mission in early 2016. Instead of reliance on TRMM data, a modelled precipitation approach is being developed. This approach allows for the use of multiple input data sources (including satellite) and it has higher spatio-temporal resolution than the current model. Also, it better addresses basis risk due to a more accurate modelling approach.

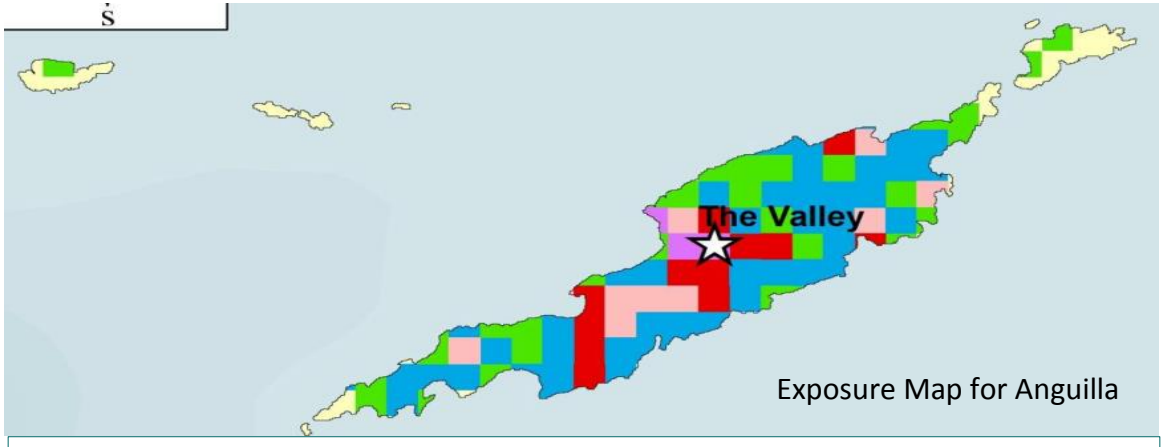
Q. How does the Excess Rainfall model work?

A. The current Excess Rainfall (XSR) model uses the iTRMM data to compile a 2-day or 3-day (depending on the country in question) running aggregate of rainfall measurements (Aggregate Rainfall) at all of the iTRMM Grid Cells across a country.



Accumulated precipitation data for Anguilla for a trough that occurred in November 2014

As with the Tropical Cyclone and Earthquake products, the MPRES exposure database is utilised to map exposures across a country at 30 arcsecond (~1 km) resolution.



A grid of ~1km^2 iTRMM cells is created to cover each country. An exposure value is attributed to each iTRMM cell and each day an Aggregate Rainfall amount is attributed to those with an exposure value greater than zero.

Since the iTRMM Grid Cells are at ~1 km resolution, the 1 km MPRES exposure data are mapped onto the iTRMM grid. This provides a distribution of the MPRES values between the rainfall measurement points covering each country.

Calculating index losses

To calculate index losses, the aggregate rainfall is calculated for each iTRMM Grid Cell. For each iTRMM Grid Cell that has aggregate rainfall over 75 mm, the single highest aggregate rainfall measurement is used to calculate the index loss by applying the indemnity rate to the exposure value of the iTRMM Grid Cell. The next step is to calculate the total index loss for the rainfall event.

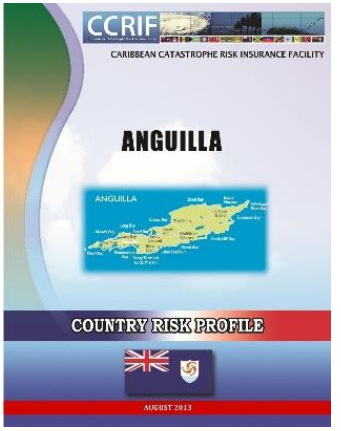
A Covered Area Rainfall Event (CARE) or national rainfall event is recorded when the total number of active iTRMM Grid Cells exceeds a threshold (known as the active percentage) identified for each country. For example, a country may be covered by 800 iTRMM cells of which 90 per cent (or 720 cells) must be active to trigger a CARE. The active percentage is specified in the country's excess rainfall policy. To calculate the Rainfall Index Loss for the CARE, the losses for the cells that contributed to the CARE are aggregated.

Data used in the CCRIF Model

Q. **Where can I find detailed CCRIF model data and risk information for a specific country?**

A. CCRIF prepares Country Risk Profiles for tropical cyclones and earthquakes as well as Rainfall Risk Profiles for member countries. The profiles provide detailed information on the catastrophe risk modelling platforms which are used to underpin CCRIF policies (the Multi-Peril Risk Evaluation System (MPRES) for tropical cyclone and earthquake policies and the KAC Rainfall Model for excess rainfall policies). These profiles provide an outline of the earthquake and tropical cyclone and rainfall characteristics and risks for the country as well as economic loss information used by the models.

The profiles are aimed at providing decision makers with a clear picture of the key risks which the country faces in order to guide national catastrophe risk management and inform decision making for both risk reduction and risk transfer (via CCRIF coverage and other mechanisms which may be available).



The risk profiles provide the basis for CCRIF to discuss coverage options with each country individually and to underwrite country policies once coverage levels have been agreed.

The development of the CCRIF catastrophe risk model is an important contribution to national and regional risk management institutions through its collection of a significant set of detailed databases on national catastrophe risk exposures in its member states. This is important specifically because prior to this initiative most member countries had for the most part never undertaken any major effort to collate this information which is critical in understanding the catastrophe risks faced at a national and regional level.

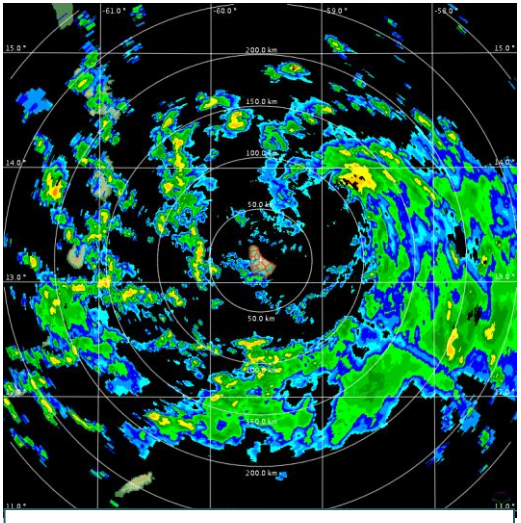
Q. Are country risk profiles publicly available?

A. Each country reviews and approves its Country Risk Profile and Rainfall Risk Profile and determines if the profiles should be made publicly available. Risk profiles for countries that have granted permission are available on the CCRIF website.

Q. Why does CCRIF use external data to determine losses for hurricanes, earthquake and excess rainfall and not a country's own data?

A. In order for CCRIF to secure reinsurance in the international market, reinsurers must trust that the information is from an independent and reliable source. Since Doppler radar and other meteorological and geophysical data collection instruments in the region are operated by institutions within the very governments purchasing the CCRIF insurance products, there could be a conflict of interest in directly using the information from these measuring sources to determine loss. There is also the issue of maintaining local measuring tools in order to ensure that they give accurate readings as well as ensuring that all member governments have the same access to the same kinds of measurement equipment, which currently is not the case. Also, using external sources provide a uniform data source across all member governments and for all hazards.

The Doppler radar does provide a good picture of wind speed as well as other storm characteristics (e.g. rainfall), and these outputs from our Caribbean member governments are fed to the National Hurricane Center (NHC) in Miami which uses that data (amongst a large amount of other data including actual measurements from dropsondes and flights – which involves meteorologists dropping equipment directly into a hurricane, in flight – to accurately measure temperature, humidity and wind speed) in their outputs.



Barbados weather radar image

Likewise, regional seismic monitoring data feeds into the United States Geological Survey (USGS) Global Data Center, which utilises the information to provide a best estimate of an earthquake location and magnitude.

The Tropical Rainfall Measurement Mission (TRMM) was selected as the rainfall data source as it provides an independent, real-time source which, while not generally as accurate as a ground-based measurement, does provide consistency across the Caribbean region in terms of data quality. Also, it provides a very high degree of dependability as it is sourced directly from NASA. The TRMM mission will be ending in early 2016, but CCRIF will continue to use satellite data as well as other input data sources.

Q. In the CCRIF catastrophe risk model, where are the base numbers for population from?

A. The population data is taken from the LandScan data source. LandScan is a satellite-derived database together with a statistical database which is compiled by several US agencies and it provides the total population count by country as well as the distribution of that population over the terrain of the country by 1 km grid cell. However, the database may not be exactly correct in relation to the latest population count in the country but it is a very good approximation. The currency of the data depends on a number of factors but it is generally up to date within 1 to 3 years.

Q. In terms of impact by wind, what consideration is given to structures – for example whether buildings are wooden or concrete?

A. When generating an exposure database for a country, CCRIF's model distributes value across a suite of building and usage types. Thereafter the model uses a family of damage functions (which describe the relationship between hazard and loss to a given building type, e.g. wooden residential structure) to estimate loss to each structure from a given level of hazard. Estimation of damage is measured in terms of

a mean damage ratio (MDR), which is the repair cost divided by replacement cost of the structure.

CCRIF Hazard Event Reports

Q. Does CCRIF report on all tropical cyclones, earthquakes and rainfall events in the region?

A. CCRIF monitors and reports on all tropical cyclone, earthquake and rainfall events in the Caribbean Basin that have the potential to affect one or more of its member countries as determined by CCRIF's Multi-Peril Risk Estimation System (MPRES) (for tropical cyclones and earthquakes) or Rainfall Model (for excess rainfall) under the terms of CCRIF's tropical cyclone, earthquake and excess rainfall policies.

For tropical cyclones CCRIF generates a report for any named tropical cyclone event which generates winds of tropical storm strength (minimum 39 mph) or above in one or more grid cells of at least one member country.

For earthquakes CCRIF generates a report for any earthquake event with a magnitude of greater than 5.0 within the CCRIF monitoring region and which generates a peak ground acceleration of at least 0.01 g in one or more grid cells of at least one member country that has an earthquake policy.

For excess rainfall CCRIF generates a report for any rainfall event, for example a tropical wave/cyclone or persistent rain, which triggers iTRMM Grid Cell Events (which occur when rainfall exceeds 75 mm in those cells) in at least 80 per cent of the total number of grid cells required to trigger a Covered Area Rainfall Event (CARE) in at least one member country that has an excess rainfall policy. The number of grid cells required to trigger a CARE is specified in the country's policy (as a percentage of total number of that country's grid cells).

These reports – referred to as event briefings – explain the model results of the hazard event and indicate if any country's policy was triggered – and if so, what the likely payout is expected to be.

CCRIF sends these reports to key finance, disaster management and meteorology stakeholders in affected member countries, all other member countries as well as other regional and international stakeholders.

Q. What is the CCRIF monitoring region?

A. The CCRIF monitoring region is an area that encompasses all of the CCRIF member countries. This is essentially a box bounded by Latitude 2° and 41°N Longitude 97° and 51° W, as shown in Figure 5.

Figure 5: CCRIF monitoring region

Accuracy of CCRIF Model

Q. What is the accuracy of the CCRIF model?

A. After the passage of every tropical cyclone that affects a member country, CCRIF invests significant amounts of time to collect information to verify the models it uses and to determine how good the model-based estimates were. CCRIF checks if its wind estimates correspond to data that come in from the automated systems in the country and if CCRIF's damage estimates correspond to the estimates made by the agencies in the country and international agencies which go to the specific countries and prepare post-event reports. These reports include the damage and loss assessment reports produced by the UN Economic Commission for Latin America and the Caribbean (UNECLAC) and the Caribbean Institute for Meteorology and Hydrology (CIMH) post-event reports as well as national reports where they are available.

CCRIF's hazard estimates as verified over the past years are quite close to the observations made in the countries and observations made by the wind measurement stations and so on. Impact estimates can only be compared to reports as they come in from the countries after every event, providing estimates of the impact in terms of how many houses were destroyed or partially destroyed, how many people were affected, what is the total

damage to the schools and roads, etc. Those estimates are often not consistent even within the same country because different agencies will produce different estimates. It is therefore very difficult to agree on a final damage estimate.

CCRIF's comparison of damage estimates over the years has revealed that in general there is an acceptable correspondence between the CCRIF estimates and the reports. CCRIF recognises that a government wants a specific number which represents the damages and that it is a challenge for disaster managers who have to inform government officials and the political leadership about what happened during a storm event. Our advice is to use as many sources as possible and convey the fact that estimates based on modelling always will be just estimates and cannot be exact numbers – but that there is also uncertainty associated with numbers on the ground.

Mr. Isaac Anthony, CEO, CCRIF SPC (right) presents a cheque for US$0.5M to Anguilla's Chief Minister Hon. Hubert Hughes (left) on October 29, 2014. The payment represented the payout under Anguilla's excess rainfall policy, which was triggered by heavy rains when Hurricane Gonzalo passed over the island on October 13th.

Mr. Martin Cox, Director of Finance and Economic Affairs receives a cheque for US$1.28M from CCRIF Board Member Mrs. Faye Hardy at a ceremony on December 8, 2014. At left is CCRIF Board Member Mrs. Desirée Cherebin. The payment represented the payout under Barbados' excess rainfall policy which was triggered by rains from a trough system in the Eastern Caribbean in November.

Triggering of CCRIF Policies

Q. How is a CCRIF policy triggered?

A. The trigger level is dependent on the coverage purchased by individual countries. Member governments may purchase coverage which starts to pay out for a '1-in-10-year' hurricane or a '1-in-20-year' earthquake, for example, with maximum coverage of approximately US$100M currently available for each peril. The cost of coverage for a country is directly proportional to the amount of risk being transferred by that country to CCRIF.

A CCRIF policy pays out based on the government loss estimated in the loss model, which in turn is based on the characteristics of the hazard event and the distribution and exposure of national assets at risk relative to the hazard impacts (see section on the CCRIF model for details).

The policy is triggered when the modelled loss for a hurricane, earthquake or rainfall event in a member country equals or exceeds the attachment point deductible) specified in the policy contract.

Q. Is there an example of how the attachment point affects the triggering of a policy?

A. With a 20-year attachment point return period for a policy there is a high probability of that policy being triggered for a 1-in-20 year event (i.e. an event what occurs with a certain severity once every 20 years). If the attachment point return period were changed to 15 years – with all other elements of the policy remaining the same – the attachment point dollar value would be lower and the policy would be more likely to trigger in any given year than with the 20-

The return period is the expected time between hazard events of a certain magnitude.

year return period. In effect, this would signify that the policy provides coverage for events that occur more frequently.

However, the premium for this broader coverage would be higher. With all other things constant, a policy with a 15-year return period would have a higher premium than one with a 20-year return period, but it would trigger for a less severe event, thus providing a payout to the country.

CCRIF Policy Payouts

Q. How are payouts calculated?

A. Once a loss is calculated in the model for a given country, the specific payout totals are based on the level of coverage a country has. This modelled loss is designed to replicate as closely as possible the losses felt on the ground. Each country chooses its own coverage options in terms of the attachment point (deductible), exhaustion point (coverage limit) and premium. The amount of the premium dictates how much of the risk between the attachment and exhaustion points a country is actually covered for.

Tropical cyclones The CCRIF payout for tropical cyclones is based on the loss assessment from the storm as it happens. CCRIF runs the storm track and characteristics in the model after it has impacted the country and computes all losses from wind as well as from wave and storm surge in the coastal areas. A payout to a country would depend on the storm's intensity and track relative to the distribution and value of assets and on the attachment and exhaustion points and coverage limit that the country has selected. Once the initial payout trigger level (the attachment point) has been reached, the payout increases as the modelled loss increases, due to higher hazard intensity or a closer track (or both) for the storm (relative to the distribution and value of assets).

Payouts for hurricanes are determined based on government losses calculated using storm data from the National Hurricane Center and parameters fixed within the loss estimation model used to underpin CCRIF's policies. The model calculates the level of wind and ocean hazards, such as storm surge encountered across the affected area and uses the pre-fixed value and distribution of exposures to calculate a government loss.

Earthquakes In the case of earthquake policies, the loss depends on the source magnitude and hypocentre (location and depth) of the earthquake using data obtained from the United States Geological Survey. These data are translated into a ground shaking intensity across each affected country which in turn drives generation of a modelled loss via the same exposure database as described above for tropical cyclone losses. The payout increases as the level of losses increases until the policy limit is reached.

The magnitude 8.0 earthquake that affected Haiti in January 2010 triggered the full policy limit for Haiti's earthquake coverage. The Government received US$7.75 – approximately 20 times their premium for earthquake coverage of US$385,500.

Excess Rainfall In the case of excess rainfall policies, a payout to a country depends on the peak Aggregate Rainfall for the event, the distribution of high rainfall relative to exposure, and the proportion of the country/exposure impacted. As the index loss increases above the attachment point the payout increases as the Rainfall Index Loss increases, until the maximum payout (coverage limit) has been reached.

Q. How many payouts has CCRIF made since its inception?

A. Since its inception in 2007, CCRIF has made 12 payouts totalling US$35,572,474 to 8 member governments (see table below). All payouts were available to be transferred to the respective governments within two weeks after the event and in three cases, interim payments were requested and made one week after the event.

Event	Country Affected	Policy Triggered	Payout (US$)
Earthquake, 29 November 2007	Dominica	Earthquake	528,021
Earthquake, 29 November 2007	Saint Lucia	Earthquake	418,976
Tropical Cyclone Ike, September 2008	Turks and Caicos Islands	Tropical Cyclone	6,303,913
Earthquake, 12 January 2010	Haiti	Earthquake	7,753,579
Tropical Cyclone Earl, August 2010	Anguilla	Tropical Cyclone	4,282,733
Tropical Cyclone Tomas, October 2010	Barbados	Tropical Cyclone	8,560,247
Tropical Cyclone Tomas, October 2010	Saint Lucia	Tropical Cyclone	3,241,613
Tropical Cyclone Tomas, October 2010	St. Vincent & the Grenadines	Tropical Cyclone	1,090,388
Tropical Cyclone Gonzalo, October 2014	Anguilla	Excess Rainfall	493,465
November Trough, 7-8 November 2014	Anguilla	Excess Rainfall	559,249
November Trough, 7-8 November 2014	St. Kitts & Nevis	Excess Rainfall	1,055,408
Trough System, 21 November 2014	Barbados	Excess Rainfall	1,284,882
Total for 2007 - 2014			**US$ 35,572,474**

Q. Do CCRIF payouts cover all losses from a hazard event?

A. No. CCRIF policies cover "government loss" as a proportion of the full "national loss". CCRIF was designed to provide funds within 14 days to assist governments with immediate needs following a catastrophe event. The exact payout amount is based not only on the modelled losses after a tropical cyclone, earthquake or rainfall event, but also on the terms of the policy selected by the country – the amount of risk transferred to CCRIF and the maximum payout limit.

Q. Are there any restrictions on the use of CCRIF payouts?

A. No. Governments can use CCCRIF payouts for any purpose. In the past, countries have used CCRIF funds to: pay Government salaries right after an event disrupted normal operations; repair infrastructure, including bridges and roads; supplement the general budget; and institute mitigation measures to increase their country's resilience.

There are no restrictions on what CCRIF payout funds can be used for.

Hazards Included in Policies

Q. Are countries' policies based on individual country hazard assessments?

A. Yes. CCRIF uses the entire history of hurricanes (since the 1870s for the Atlantic and 1940s for the Pacific) and earthquakes (since the 16th Century) as a basis for simulating hazard events covering 1,000 years for hurricanes and 10,000 years for earthquakes, thus taking into account events which might happen in the future but which have not necessarily happened in the historical period. For excess rainfall policies, TRMM data for events since 1998 are used.

Through this mechanism, CCRIF generates detailed hazard information for each country (at a resolution of ~1 km^2), which is then used to assess the risk. For example, Eastern Caribbean islands more to the south like Grenada and St. Vincent are less susceptible to major hurricanes than the islands in the main Hurricane Belt like Antigua & Barbuda, so their hurricane hazard level is lower. Thereafter, for a given set of coverage conditions and given exposure and vulnerability, the premium, comparatively speaking, will be lower because their risk is lower. Thus, every island is assessed as to its own individual risk level and this is the basis for pricing of the insurance product for that country. So there is no cross-subsidisation of premium in the pool.

Q. What hazards are included in the Tropical Cyclone payout calculation?

A. Hazards that drive the computation of losses due to tropical cyclones are wind in all areas and storm surge in coastal areas where assets can be at risk from storm surge inundation.

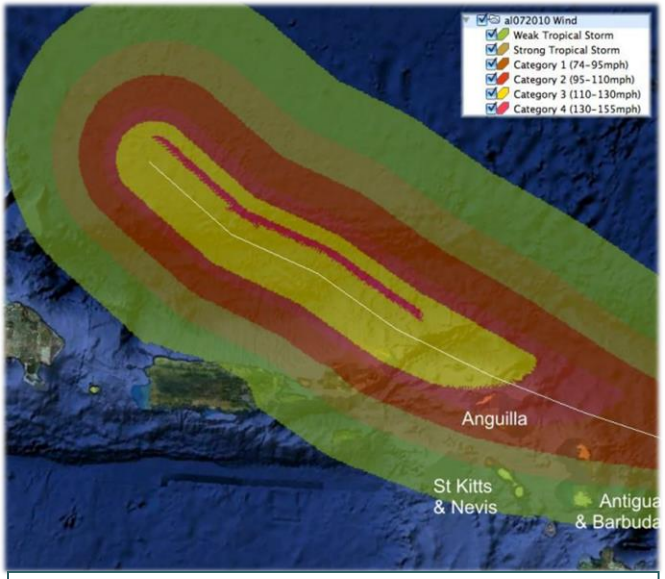
Q. Is rainfall included in the Tropical Cyclone payout calculation?

A. No. CCRIF's Tropical Cyclone Policy is based on wind and storm surge only. CCRIF's Excess Rainfall Policy provides coverage for excess rainfall events and is purchased separately from the Tropical Cyclone Policy.

Q. What is the strength of winds that cause a Tropical Cyclone policy to trigger e.g. Category 1 etc.?

A. This differs from one country to the next as it depends on the policy parameters (attachment and exhaustion points) of individual countries as well as assets affected and other physical characteristics of the storm such as distance from the affected country.

CCRIF's modelled loss approach provides a much more sophisticated approach to parametric insurance than just relying on wind strength of a given storm as some simpler parametric policies do.



In August 2010, Tropical Cyclone Earl triggered Anguilla's TC policy but not the policies of the other two affected CCRIF countries – Antigua & Barbuda and St. Kitts & Nevis.

CCRIF Policy Elements

Q. What are the three key decisions that countries must make with respect to their policy selection?

A. Regarding CCRIF policies and coverage selection, all countries are required to make three key decisions regarding their coverage selection. These are:

- The selection of an attachment point
- The selection of an exhaustion point
- The selection of the coverage limit (which is tied to the ceding percentage and dictates the premium cost)

Q. What are the key elements of CCRIF policies?

A. Attachment Point

The attachment point can be described as the minimum severity of the event loss which gives rise to a payment and therefore is the loss value at which the policy contract is triggered. The attachment point therefore functions like a deductible in a standard insurance policy.

Payouts are made on the policy when the modelled loss for an event in a member country equals or exceeds the attachment point specified in the contract. The specific country covers all losses below the attachment point for any event.

The attachment point applies equally to each individual storm, earthquake or rainfall event. There is no accumulation of attachments (deductibles) from loss events for which the modelled loss was less than the attachment point.

For example, an attachment point selected for a 1-in-15-year event represents the loss amount (in dollars) which is likely to be exceeded once in fifteen years. While countries generally select the attachment point as a return period (for example, 15 years representing a 1-in-15 year tropical cyclone), the policy includes the equivalent dollar value of loss which that return period represents in the country's risk profile.

Exhaustion Point

The exhaustion point refers to the severity of the event loss at or above which the maximum payment is triggered. As with the Attachment Point, the return period selected as the Exhaustion Point is converted into a dollar value in the Policy.

Ceding Percentage

The ceding percentage is the portion of the losses that CCRIF will cover under the policy. It is the fraction of the risk between the attachment and exhaustion points that the country is transferring to CCRIF.

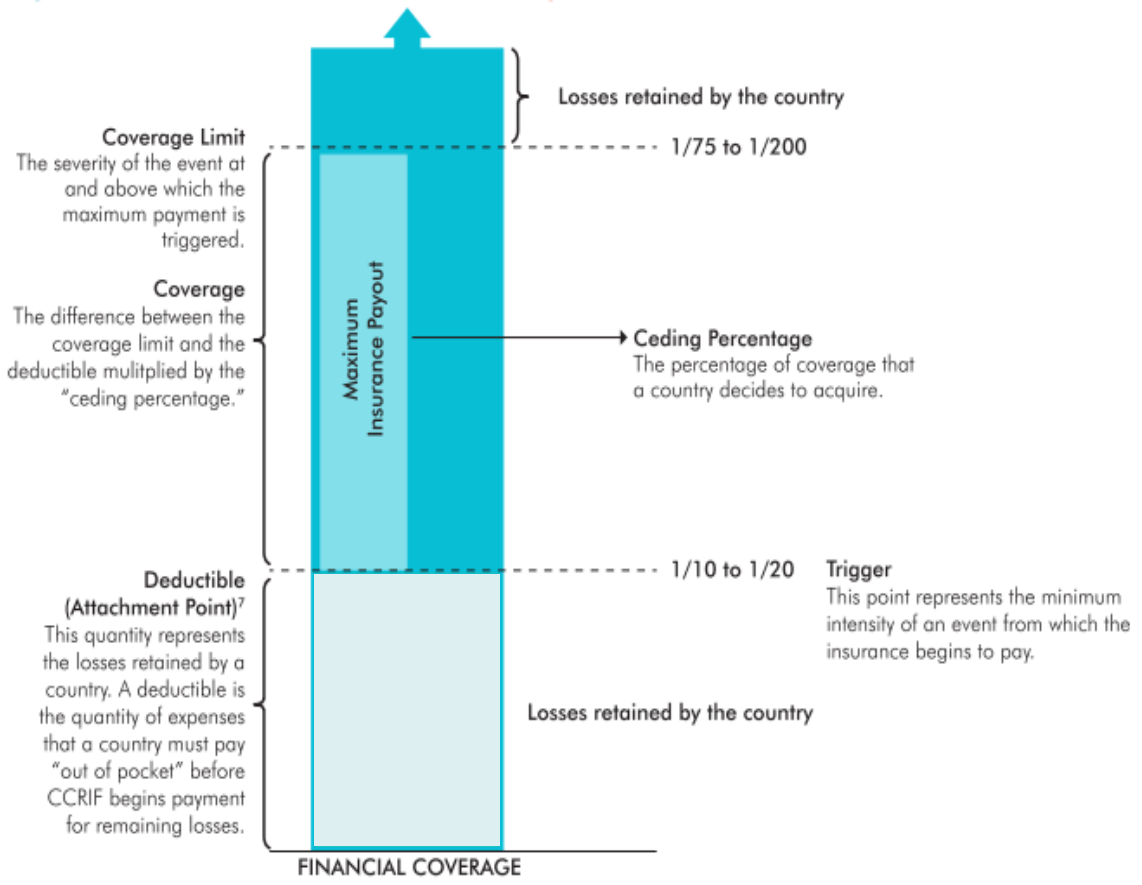
Once the attachment point and exhaustion point are chosen, there is a one-to-one relationship between the amount of premium paid and the ceding percentage – a higher ceding percentage means a higher premium.

Coverage or Policy Limit

The policy/coverage limit is the total amount that can be paid out under a policy. It is the difference between the attachment and exhaustion points (exhaustion minus attachment) multiplied by the ceding percentage (the amount of risk between the attachment and exhaustion points that the country is transferring to CCRIF).

The coverage limit is the maximum amount that can be paid out under the contract in any one year for any one peril (tropical cyclone, earthquake or rainfall event). Payouts for events that have a modelled loss that exceeds the exhaustion point are paid out at the coverage limit. The policy limit applies to the full term (one year) of the contract. The total amount paid out under the contract during the one-year period will not exceed the policy limit, whether that policy limit is due to payout from one large event or multiple smaller events that each trigger payments under the contract. The coverage limit that is selected will depend on the capacity of the country to absorb losses and also on what premium the country wishes to pay.

Figure 6 shows the elements of a CCRIF policy with some example attachment and exhaustion point return periods.



7. The attachment point can be described as the minimum severity of the event loss which gives rise to a payment and therefore is the loss value at which the policy contract is triggered. The attachment point therefore functions like a deductible in a standard insurance policy.

***Figure 6: Elements of a CCRIF Policy*[2]**

[2] Adapted from *Caribbean and Central American Partnership for Catastrophe Risk Insurance*, World Bank, 2014.

Q. What are some typical values of attachment and exhaustion point return periods selected by CCRIF members?

A. For the 2014/2015 policy year, for example, CCRIF member countries selected attachment point return periods in the range 10 - 30 years for tropical cyclones; 20 - 100 years for earthquakes and 5 years for excess rainfall events.

For the 2014/2015 policy year, CCRIF member countries typically selected exhaustion point return periods in the range of 75 - 180 years for tropical cyclones; 100 - 250 years for earthquakes and 25 years for excess rainfall events.

Each country must decide on the attachment and exhaustion points based on its risk profiles (for tropical cyclones, earthquakes and rainfall) and on the amount of premium they wish to pay. For example, countries that are more prone to earthquakes may decide to select lower return periods for earthquakes.

Q. How is the premium cost determined?

A. The premium is determined by the amount of coverage (coverage limit) a country decides to take, the attachment and exhaustion points of that coverage, and the risk profile of the country.

Q. Is there a limit on the number of events covered per year?

A. There is no limit in terms of how many events per year that a policy can cover. The real issue is the specific amount of coverage purchased relative to the impact of an event on a given country in a given year. Every event must generate a modelled loss higher than the Attachment Point to be eligible for a payout, but thereafter, payouts are only limited by the Coverage Limit for the policy year.

Q. How are CCRIF policies renewed?

A. CCRIF policies are renewed on June 1st every year and last for one year. Each year, countries have the opportunity to consider their coverage characteristics (deductible and policy limit) and premium level for existing policies as well as obtaining coverage for new perils (for example excess rainfall). CCRIF has been able to reduce premiums each year and aims to continue to keep prices as low as possible while maintaining a level of financial security which will ensure that it can pay claims in full even for the largest events.

Insurance Considerations for CCRIF Members

Q. Are countries purchasing adequate coverage?

A. CCRIF believes that adequate coverage would be 20 to 25 per cent of the overall government exposure to earthquake and tropical cyclone risk – both on an ongoing basis (*i.e.* relative to the average annual loss) and particularly for larger shock events. For most current member countries, the level of coverage is directly related to the amount of premium they can afford. Increase in coverage is constrained by limited public finances due to the downturn in performance of economies in 2008, increases in fiscal deficits and escalating debt.

CCRIF has sought to minimise premium costs wherever possible – by decreasing premium cost by 10 per cent in each of the first three years; offering premium rebates after claims-free years; allowing access to premium financing from

countries' participation fees (a one-time payment made when each country became a member of CCRIF); and arranging special prices for a package of different policies.

Q. What is the relationship between CCRIF and other insurance providers in the region – in terms of influencing company policies provided at the national level?

A. There is no relationship between CCRIF and other insurance companies for its sovereign (national) products – the tropical cyclone, earthquake and excess rainfall policies. CCRIF is a regional insurance fund specifically targeted at providing liquidity coverage for governments.

However, CCRIF does have relationships with local insurance companies in development of the Loan Protection Cover (LPC) – an insurance mechanism that provides protection against default for financial institutions that have significant portfolios of individual and small business loans exposed to weather risks. Also, local insurance companies are responsible or selling the Livelihood Protection Policy (LPP), the other product developed under the project. The LPP provides insurance coverage to low-income individuals for extreme weather events such as rainfall and wind.

CCRIF is working with local insurance companies in development of the Loan Protection Cover for financial institutions.

Q. Is there any risk of CCRIF being unable to make payments based on claims, for example if there were events in a number of countries?

A. CCRIF has done an extensive amount of financial modelling and analysis in order to ensure that it is able to meet the claims-paying requirements necessary for a regional institution. Through pooling of risks among countries and building a strong capital base supplemented by reinsurance, it is ensured that CCRIF can make

payouts for a series of events with a less than a 1-in-1,000 chance of occurring in any one year. While 1-in-1,000 is the survivability level that is incorporated into CCRIF's Operations Manual, currently CCRIF is even more secure than this.

This essentially means that there would need to be several massive catastrophes occurring in a number of the large economies across the region: for example Jamaica being hit, as well as Barbados, Trinidad, Cayman and Bahamas within a given year. This is of course a possibility but CCRIF has tried to include or incorporate within the financial aspects of the Facility the ability to actually satisfy those claims. If claims from member governments in any one year exceeded CCRIF's capital and reinsurance then there are guidelines in place for how that would be dealt with and claims would be paid on a proportional basis until all funds were used up.

For the Central American countries, the assets of the Central American pool will be held separately, so the same principles will apply. Large claims in the Caribbean would not be able to draw capital from the Central American pool and likewise, large claims in Central America would not deplete the Caribbean capital.

Q. What is the impact of natural hazards on the Caribbean and Central America?

A. The Caribbean and Central America face a number of primary natural hazard risks, particularly earthquake and tropical cyclone (hurricane) risks, and to a lesser extent volcanic risks in certain areas. The region also faces secondary risks from flooding and landslides, storm surge and wave impacts, and tsunamis.

The most significant natural hazard risk in the Caribbean is hurricane risk, particularly because of the possibly large span of territories which can be impacted by any single event. Hurricanes have an inordinate impact on the economies of Caribbean countries, many of which depend on tourism and agriculture as their main economic drivers.

A case in point is Hurricane Ivan, which caused billions of dollars of losses across the Caribbean in 2004. In both Grenada and the Cayman Islands, losses were close to 200% of their national annual gross domestic product (GDP) and a further 7 countries were also severely impacted. Regional losses totalled over US$ 6 billion for the event.

Hurricane Ivan caused billions of dollars of losses across the Caribbean in 2004

The inordinate impact of natural hazards on GDP is reflected throughout the region. Since 1980, ten countries in the Caribbean and Central America have experienced a disaster

event with an economic impact greater than 50 per cent of their annual GDP. These countries are: Saint Lucia (1980), Jamaica (1988), Antigua and Barbuda (1995), Dominica (1995), Saint Kitts and Nevis (1995, 1998); Honduras (1998), Grenada and Cayman (2004), Guyana (2005) and Haiti (2010).

By contrast, Hurricane Katrina, which devastated the US states of Louisiana and Mississippi in 2005 and is acknowledged to be the costliest natural disaster in US history, caused damages that represented only 1-2% of the US national GDP for that year. Furthermore, while Katrina contributed to a short-term in reduction in GDP growth at the national level, within six months national GDP growth had increased. Similarly "Superstorm" Sandy, which damaged the northeastern US in 2012, had only a modest effect on overall US GDP.

CCRIF's Role in Disaster Risk Financing

Q. Can countries rely solely on CCRIF policies as a mechanism for their disaster risk financing?

A. No. CCRIF provides options for managing a portion of the identified risk, but CCRIF's parametric insurance policies should not be viewed as a panacea. CCRIF policies should be used in conjunction with other disaster risk financing mechanisms to provide a comprehensive national risk financing strategy which best balances budgetary conditions with the need to manage the ongoing economic liability which natural disasters present.

Effective budget management should allow for rapid mobilisation of resources in case of a disaster, while protecting fiscal accounts. Governments should build a financial protection strategy that combines a number of instruments that address different layers or types of risk. Such a strategy incorporates budget allocations and reserves, contingent credit, and risk transfer instruments as shown in Figure 7. CCRIF is an example of a risk transfer solution for the high risk layer (e.g.,

hurricanes and earthquakes) that should complement instruments used to address lower risk events such as local floods and landslides

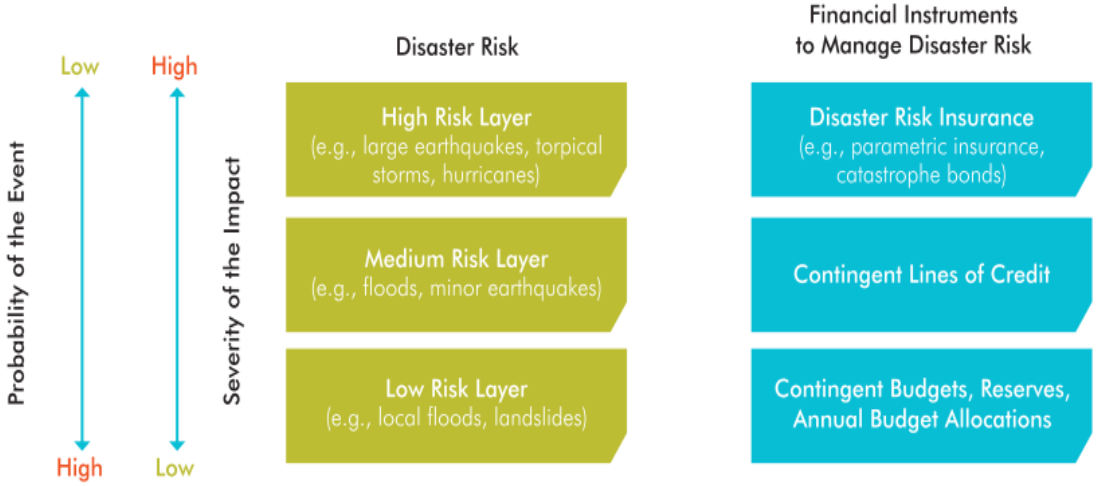


Figure 7: Risk layers and corresponding disaster risk management instruments[3]

Q. Do countries need both risk transfer and risk mitigation strategies?

A. Yes. While risk transfer such as CCRIF catastrophe insurance is an important tool that will help to provide funds to handle post-event recovery, thus reducing the costs to Governments to deal with natural hazards, this should be accompanied by risk mitigation (or reduction) activities to reduce vulnerability to natural hazards (and thus preventing them from becoming "natural disasters").

Both risk transfer and risk mitigation should be part of a country's comprehensive disaster management (CDM) strategy and each country must decide the proportion of its risk management portfolio which should be based on risk mitigation and on risk transfer. While reducing current and future risk must be a priority, there is a threshold at which investment in risk transfer is more cost-efficient than risk

[3] From *Caribbean and Central American Partnership for Catastrophe Risk Insurance*, World Bank, 2014

reduction. This threshold varies from country to country. For example, in some countries only a small share of the expected loss can be expected to be averted cost-effectively using risk mitigation measures. To address the risk beyond this level, it may be economically more effective to purchase a risk transfer solution than to implement further risk mitigation measures.

Risk transfer solutions are particularly effective in the case of low-frequency and high-severity events. **Risk mitigation** activities include asset-based responses (such as constructing sea walls, "wind-proofing" buildings, reviving coral reefs and making coastal areas flood-proof) and behavioural measures (such as enforcing building codes and zoning restrictions).

A hurricane strap provides extra support for a roof

Q. Why is it important for ex-ante financing to be part of a country's disaster management strategy?

A. A government facing a natural catastrophe will not require funding for its entire recovery and reconstruction programme immediately following the event. While immediate resources will be necessary to support relief operations, most needed funds will only be required several months later, when the actual reconstruction programme starts. The design of an efficient financial protection strategy must take this time dimension into

account to ensure that funding requirements are matched with capacity to disburse funds when required.

It is important for governments to include both ex-ante and ex-post financing instruments in its disaster risk management strategies. Ex-post financial instruments are sources that do not require advance planning and include budget reallocation, domestic credit, external credit, tax increases, and donor assistance.

Ex-ante risk financing instruments require proactive advance planning and include reserves or calamity funds, budget contingencies, contingent debt facility, and risk transfer mechanisms such as catastrophe insurance or catastrophe bonds. Purchasing CCRIF policies is an example of ex-ante planning – planning before a hazard event occurs – and governments know that if a policy is triggered they will receive a payout within 14 days of the event. Examples of ex-ante and ex-post financing are shown in Figure 8.

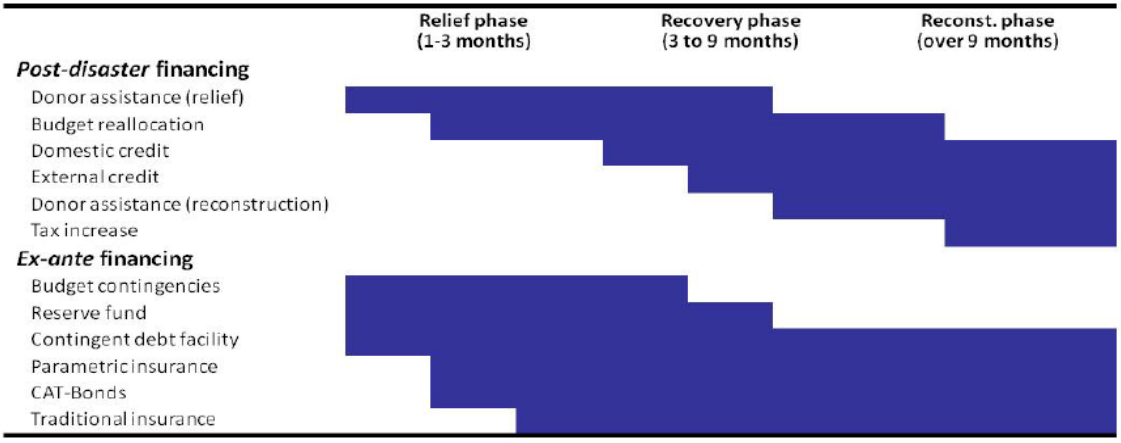


Figure 8: Examples of ex-post and ex-ante disaster financing[4]

[4] Source: *Sovereign Disaster Risk Financing*, GFDRR, World Bank. 2011.

Q. How can risk financing support national fiscal policy?

A. As losses from natural hazards continue to increase, countries are compelled to include disaster risk financing – which includes catastrophe insurance as an indispensable component – as a major part of fiscal policy. Economic, fiscal and physical planning policies can all reduce exposure to hazards, but to be successful, these policies need to be based on national disaster risk assessments. It is critical for governments in the region to integrate disaster risk management into economic and fiscal planning, bearing in mind the potential impact of a hazard such as a single hurricane on key economic indicators such GDP and debt, and the region's growth agenda. Budgeting for disaster risk and including strategies for managing disaster risk in wider fiscal policy results in funds being available for recovery immediately after an event as well as for medium-and long-term rebuilding efforts.

CCRIF's Involvement with other Insurance Products

Q. Does CCRIF provide any microinsurance products?

A. CCRIF is involved in a microinsurance project, the Climate Risk Adaptation and Insurance in the Caribbean Project, implemented by Munich Climate Insurance Initiative (MCII), in collaboration with CCRIF, MicroEnsure and MunichRe. The project is supported by the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU). It aims at protecting the livelihood of low-income people against extreme weather events (specifically, excess rainfall and high winds) – which are expected to be exacerbated by climate change.

The project has developed two products in three countries (Saint Lucia, Jamaica and Grenada):

- The Livelihood Protection Policy (LPP) provides low-income people with funds within a short period of time that would allow them to rebuild their farm, small enterprise and/or livelihood after an extreme weather event. The LPP is offered through local insurance companies.

Farmers in Saint Lucia received quick payouts on their Livelihood Protection Policies after the December 2013 rains that affected the Eastern Caribbean.

- The Loan Portfolio Cover (LPC) will provide portfolio-level protection against default for lender institutions such as development banks and credit unions which have significant portfolios of individual and small business loans exposed to weather risks. CCRIF will be the sole insurer selling and managing the LPC in the Caribbean.

Q. Where can Livelihood Protection policies be purchased?

A. The LPP can be purchased from the following insurance companies in three countries:

- Saint Lucia: EC Global Insurance Co. Ltd.
- Jamaica: Jamaica International Insurance Company
- Grenada: Trans-Nemwil Insurance Ltd. in collaboration with
  Grenada Co-operative Bank Limited and
  Granville Co-Operative Credit Union

Q. Is CCRIF involved in agriculture insurance?

A. CCRIF realises the importance of agriculture coverage in the region and has engaged with regional partners such as Jamaica's Ministry of Agriculture in discussions related to possible agriculture coverage options. These efforts will continue.

At the microinsurance level, the Livelihood Protection Policy – developed under the MCII project – can be purchased by small farmers to provide coverage for their farms. In 2014, farmers in Saint Lucia received payouts on their policies after the December 2013 rains that affected the Easter Caribbean. Notification of the payouts was sent to policy holders via text message and payments were received within two weeks.

Q. Could the CCRIF mechanism be applied in other regions?

A. Yes and such an idea has been included in the negotiating text on climate change adaptation as part of the UN Framework Convention on Climate Change (UNFCCC) process. CCRIF was used as a template in the formation of the Africa Risk Capacity (ARC) and also is being discussed by countries in the Pacific as they seek to strengthen regional and national mechanisms to address disaster and climate risk management.

CCRIF Support for Comprehensive Disaster Management Initiatives – the CCRIF Technical Assistance Programme

Q. Other than providing parametric insurance, does CCRIF play a role in comprehensive disaster management in the region?

A. Although CCRIF's mandate is to provide catastrophe insurance to its members, CCRIF does contribute to other initiatives related to disaster risk management. The facility views comprehensive disaster management (CDM) as an integral component of regional development and shares the overall goals of Caribbean and Central American nations of promoting sustainable economic growth, ensuring environmental, social and fiscal sustainability and reducing poverty.

CCRIF is a full partner in capacity development for disaster risk management (DRM) in the Caribbean and will aim to be in Central America as well. As such, CCRIF has been implementing a Technical Assistance Programme since 2009, which aims to help member countries deepen their understanding of natural hazards and catastrophe risk, and the potential impacts of climate change on the region.

CCRIF is actively involved in supporting the region in disaster management efforts through partnerships with key regional organisations, capacity building initiatives, education, research and development, knowledge sharing and providing tools – such as the Real-Time Forecasting System (RTFS) – for greater proactive disaster preparedness and management. CCRIF has memoranda of understanding with the Caribbean Community Climate Change Centre (CCCCC), Caribbean Disaster Emergency

Under the CCRIF-SRC MOU, SRC has installed accelerometers to measure earthquake risks in 8 Caribbean countries.

Management Agency (CDEMA), Caribbean Institute for Meteorology and Hydrology (CIMH), Inter-American Development Bank (IDB), Organisation of Eastern Caribbean States (OECS), University of the West Indies (UWI), Seismic Research Centre (SRC) at UWI and UN Economic Commission for Latin America and the Caribbean (UNECLAC).

Q. Does CCRIF provide technical assistance to individuals or communities?

A. Yes. CCRIF's Technical Assistance programme has three programmes targeted at individuals and/or communities as follows:

Scholarship programme – provides scholarships to Caribbean students to study at UWI and other universities within and outside the region in areas related to disaster risk management. Since 2010, CCRIF has provided 31 scholarships valued at over US$470,000.

CCRIF CEO, Mr. Isaac Anthony (2nd right), with UWI Registrar, Mr. Clement Iton (1st left) and two of CCRIF's scholarship recipients for 2012/13, Herona Thompson (3rd left) from Jamaica and Carina Rouse (1st right) from Anguilla, both reading for Geography degrees at the Mona Campus. Also in the photo is Dr. Angella Stephens (2nd left) from the UWI undergraduate scholarship department.

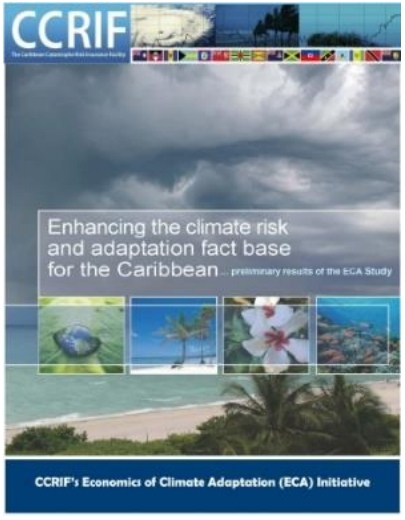
Regional internship programme – provides opportunities for students who have specialised in the areas of disaster risk management, environmental management, risk management, actuarial science, geography, climate studies and other similar areas may be assigned to regional organisations where their educational experience can be enhanced through practical work assignments.

Small grants programme – finances small projects being conceptualised and managed by non-governmental organisations (NGOs), community-based organisations (CBOs), charity organisations and/or mandated by National Disaster Coordinators in local communities across CCRIF member countries and/or CARICOM member countries.

CCRIF Involvement in Climate Change Activities

Q. **Is CCRIF involved in climate change related activities in the region?**

A. Yes. CCRIF has engaged in partnerships with the Caribbean Community Climate Change Centre (CCCCC) and the Inter-American Development Bank (IDB) to conduct work related to climate change adaptation in the region. Also, CCRIF has been involved in global discussions on the use of insurance mechanisms to address some of the risks posed by climate change, as part of the UNFCCC[5] process.



One example of climate change related work was a study on the Economics of Climate Adaptation in the Caribbean. Caribbean leaders and decision makers have recognised the need for sound quantitative data to support the development of national climate

[5] United Nations Framework Convention on Climate Change

adaptation strategies, plans and programmes. To facilitate this, CCRIF – and partner organisations – conducted a study for the Caribbean region in 2010 to create a knowledge base which would provide valuable information to decision makers about the optimal use of limited resources for adaptation.

Based on the Economics of Climate Adaptation (ECA) methodology developed by the ECA Working Group[6], the study provides the facts and tools required to develop quantitative adaptation strategies that can be incorporated into national development plans to increase resilience against climate hazards. The fact base is built around two elements:

- A risk baseline, providing transparency on current and future expected losses from climate risks for three climate scenarios. The assessment of the future risk baseline is based on the concept of total climate risk, i.e., the total future risk that could arise from adding the effects of climate change and economic growth to the current risk level
- An assessment of adaptation measures that could be taken, including an analysis of the expected costs and benefits of risk mitigation and transfer measures

The study in the Caribbean focused on the following three questions:

1. Where and from what are we at risk?
2. What is the magnitude of the expected loss?
3. How could we respond?

It was implemented by CCRIF and regional partners, including the CCCCC and UN Economic Commission for Latin America and the Caribbean (UNECLAC), with analytical support provided by McKinsey & Company and by Swiss Re, which developed the loss assessment model.

[6] A consortium of public and private players including the Global Environment Facility (GEF), UNEP, Swiss Re, the Rockefeller Foundation, Climate Works, Standard Chartered, McKinsey & Company, and the European Union.

The analysis focused on quantifying the potential impact of climate change on three relevant natural hazards:

- Hurricane-induced wind damage
- Coastal flooding/storm surge
- Inland flooding due to both hurricanes and non-tropical systems

The study was conducted in eight Caribbean countries: Anguilla, Antigua & Barbuda, Barbados, Bermuda, the Cayman Islands, Dominica, Jamaica and Saint Lucia.

For each country, the study examined the impact of the three key hazards on its infrastructure (including housing) as well as the tourism and travel, industry, and service sectors. Additionally, the study analysed the economic impact of climate change in the agriculture sector for a few selected countries including detailed analyses for Belize and Jamaica. An assessment of the risk of salinisation of groundwater due to changes in rainfall pattern and rising sea levels in Jamaica was also conducted.

Q. What were the key findings of the ECA Study?

A. The preliminary results of the ECA Study can be found in the booklet, *Enhancing the Climate Risk and Adaptation Fact Base for the Caribbean … preliminary results of the ECA Study*, available on the CCRIF website. Key findings for the eight pilot countries were:

- Current climate risk is already high, with expected losses of up to 6 per cent of local GDPs. This economic damage is comparable in scale to the impact of a serious economic recession – but on an ongoing basis.
- Climate change could result in a damage increase equalling an additional 1 to 3 percentage points of GDP in the worst-case scenario.
- Some countries can avoid up to 90 per cent of the expected damage by implementing cost-effective adaptation measures.

- A balanced portfolio of risk mitigation and risk transfer measure will be needed.

Among the hazards considered, hurricane-induced wind damage is deemed to have the largest damage potential, accounting for up to 90 per cent of the overall damage. The contribution of coastal flooding/storm surge to total damage is higher in low-lying countries. In the Cayman Islands, for example, coastal flooding/storm surge accounts for about 45 per cent of total damage potential.

In the study's high climate change scenario, sea levels may rise by up to 15 mm/year (excluding local geological effects such as uplift/subsidence), and wind speeds may increase by approximately 5 per cent as a consequence of the expected rise in sea surface temperature in the hurricane genesis region.

The study concluded that overall, expected loss as a proportion of GDP could rise to between 2 per cent and 9 per cent in the high climate change scenario by 2030 as shown in Figure 9. In absolute terms, expected loss may triple between now and 2030, with wind remaining the single largest contributor. Economic growth is typically the greatest driver of the rise in expected loss, accounting for some 60 per cent of the increase in all countries, with the exception of Jamaica, where it accounts for approximately 40 per cent.

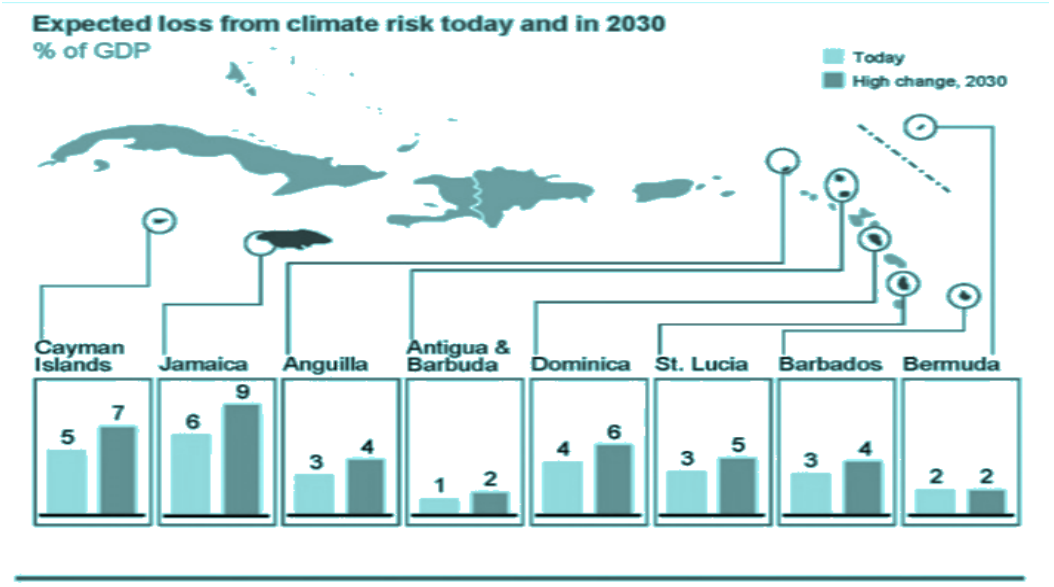


Figure 9: Expected loss from climate risk

The study also stated that some countries can avoid up to 90 per cent of the expected damage by implementing cost-effective adaptation measures and indicated that this would involve decision makers selecting both risk mitigation and risk transfer initiatives to address current climate hazards and respond to the growing threat of climate change. Risk mitigation responses are adaptation measures aimed at reducing the damage. They include asset-based responses (e.g., dykes, retrofitting buildings) and behavioural measures (e.g., enforcing building codes).

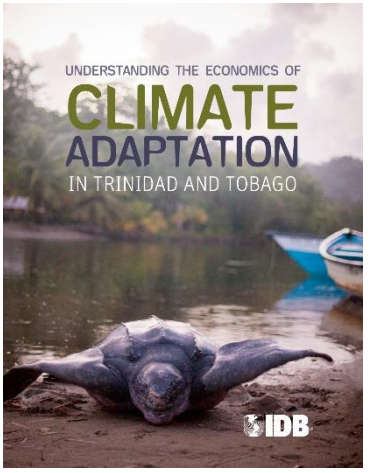
Risk transfer solutions, such as catastrophe risk insurance, are adaptation measures aimed at limiting the financial impact for people affected by distributing the risk to other players in the market. Risk transfer solutions are particularly effective in the case of low-frequency and high-severity events such as once-in-100-year catastrophes by limiting the financial impact of these events.

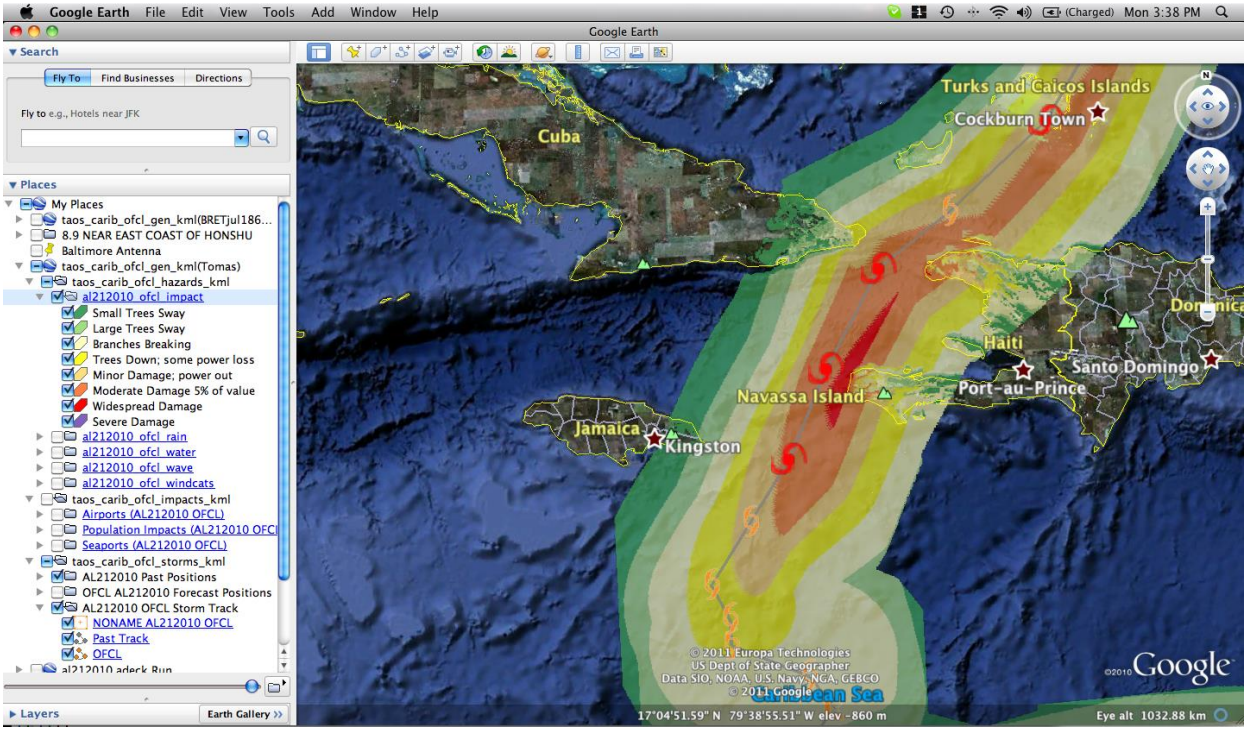
Q. What are the next steps to follow the ECA study in the eight pilot countries?

A. The next steps are to validate the preliminary findings in the eight pilot countries through discussion with national stakeholders and to expand the methodology to other countries in the region.

Q. Has the ECA methodology been used in any other Caribbean countries?

A. In 2013, CCRIF signed a MOU with the Inter-American Development Bank (IDB) to expand the ECA methodology throughout the Caribbean. IDB conducted an ECA study in Trinidad and Tobago and has produced the study report, *Understanding the Economics of Climate Adaptation in Trinidad and Tobago*.




Google Earth File Edit View Tools Add Window Help
Google Earth
Search
Fly To
Find Businesses
Directions
Fly to e.g., Hotels near JFK
Places
My Places
taos_carib_ofcl_gen_kml(BRETjul186...
8.9 NEAR EAST COAST OF HONSHU
Baltimore Antenna
taos_carib_ofcl_gen_kml(Tomas)
taos_carib_ofcl_hazards_kml
al212010_ofcl_impact
Small Trees Sway
Large Trees Sway
Branches Breaking
Trees Down; some power loss
Minor Damage; power out
Moderate Damage 5% of value
Widespread Damage
Severe Damage
al212010_ofcl_rain
al212010_ofcl_water
al212010_ofcl_wave
al212010_ofcl_windcats
taos_carib_ofcl_impacts_kml
Airports (AL212010 OFCL)
Population Impacts (AL212010 OFCL
Seaports (AL212010 OFCL)
taos_carib_ofcl_storms_kml
AL212010 Past Positions
OFCL AL212010 Forecast Positions
AL212010 OFCL Storm Track
NONAME AL212010 OFCL
Past Track
OFCL
Layers
Earth Gallery
Cuba
Turks and Caicos Islands
Cockburn Town
Haiti
Port-au-Prince
Santo Domingo
Navassa Island
Jamaica
Kingston
Caribbean Sea
© 2011 Europa Technologies
US Dept of State Geographer
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2011 Google
©2010 Google
17°04'51.59" N 79°38'55.51" W elev -860 m
Eye alt 1032.88 km

Q. What is the CCRIF Real Time Forecasting System?

A. The CCRIF Real-Time Impact Forecasting System (RTFS) is a storm impact forecast tool which provides users with real-time hurricane hazard and impact information. The RTFS is an integrated, 3D high-resolution modelling platform which is able to produce detailed information on the expected hazard levels and their impacts from tropical cyclones for the entire Caribbean region. The RTFS therefore enables all active members of CCRIF to access real-time estimates of the expected hazard levels and impacts on population and infrastructure for all tropical cyclones during the hurricane season. The RTFS hazard modules are identical to those used in CCRIF's loss modelling platform, so providing continuity between forecasted hazards and impacts (delivered via the RTFS) and final loss estimates derived in CCRIF's loss modelling platform.

Q. What is the purpose of the Real-Time Forecasting System?

A. Advanced knowledge of a hurricane's expected site-specific impacts can support effective preparedness and response, evacuation, decision making, planning for re-positioning of equipment and supplies, activation of mutual assistance arrangement and asset management in anticipation of a tropical storm or hurricane.

This real-time service provides enhanced value to participants through improving their understanding of hurricane risks and also through providing valuable real-time information to emergency and disaster managers, meteorological officers and finance/economy officials.

Some of the applications of the RTFS are outlined in Figure 10.

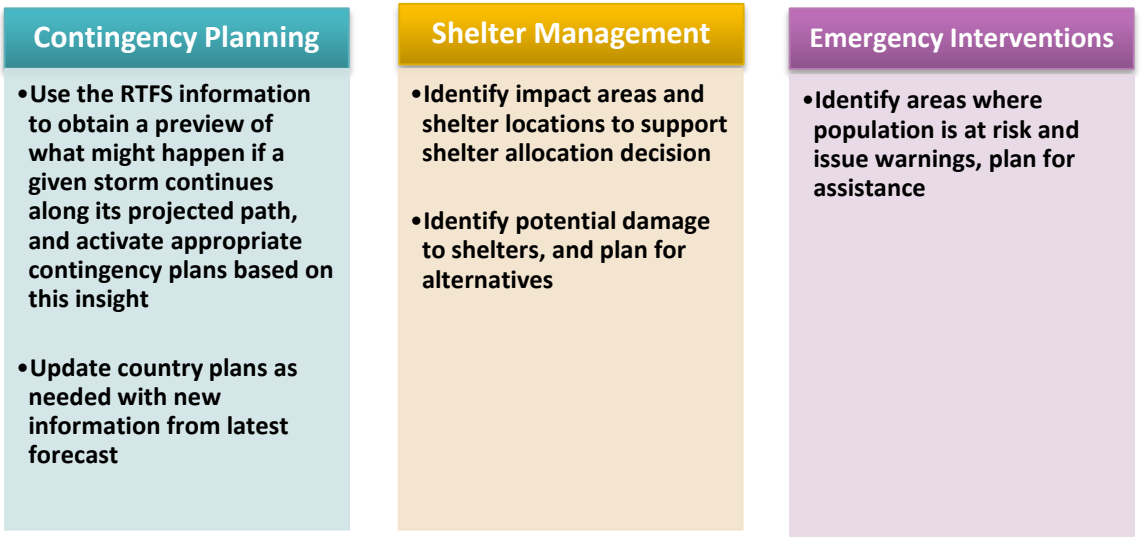


Figure 10: Uses of the Real-Time Forecasting System

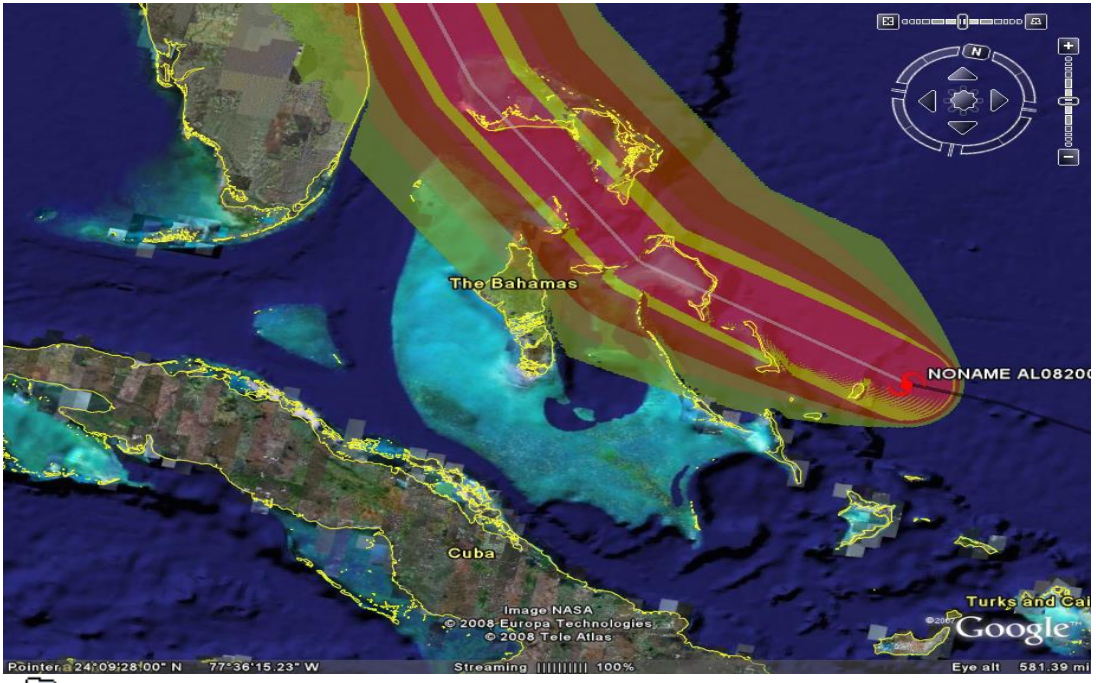
Q. What are the key features of the RTFS?

A. For all active tropical storm systems, RTFS computes the intensities of the storm hazards along the forecasted track, and the potential impact of those hazards on affected territories. This information is updated with each storm advisory issued by the National Hurricane Center (NHC). The storm modelling platform to simulate the storm uses as inputs the latest storm forecast information and other relevant weather data downloaded from the NOAAPORT satellite.

From the analysis described above, the following map and tabular information for use by CCRIF countries is provided:

- maximum expected hazard intensity for wind speed, wave and storm surge height, and cumulative rainfall across the entire impact area of the storm
- estimates of the impact on the territory by varying hazard levels
- estimates of the operational impact of the storm on major ports and airports
- maximum expected hazard values from the current storm as forecast, for up to five user-selected locations and for the maximum wind speed values, the time at which the maximum will occur

Figures 11, 12 and 13 are footprint maps of wind speed, storm surge height (peak) and wave height (peak) for various storms.



taos_ccrif_hazards_kml

al082008_ofcl_windcats

- Weak Tropical Storm
- Strong Tropical Storm
- Category 1 (74-95mph)
- Category 2 (95-110mph)
- Category 3 (110-130mph)
- Category 4 (130-155mph)
- Category 5 (over 155mph)

Figure 11: Wind Speeds (Maximum)

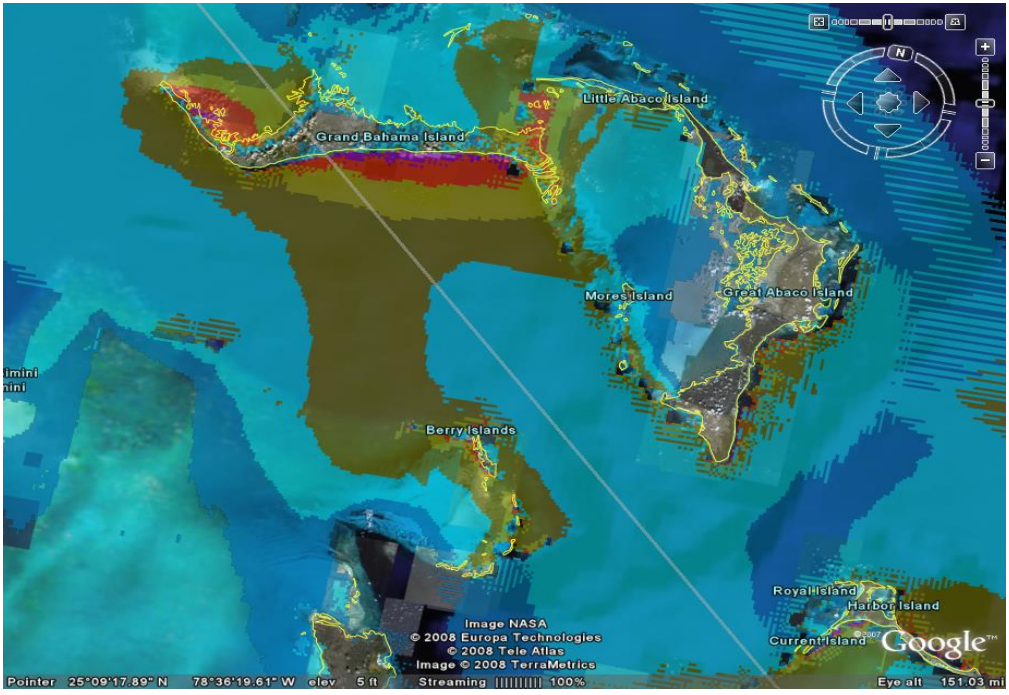


Figure 12: Storm Surge Heights (Peak)

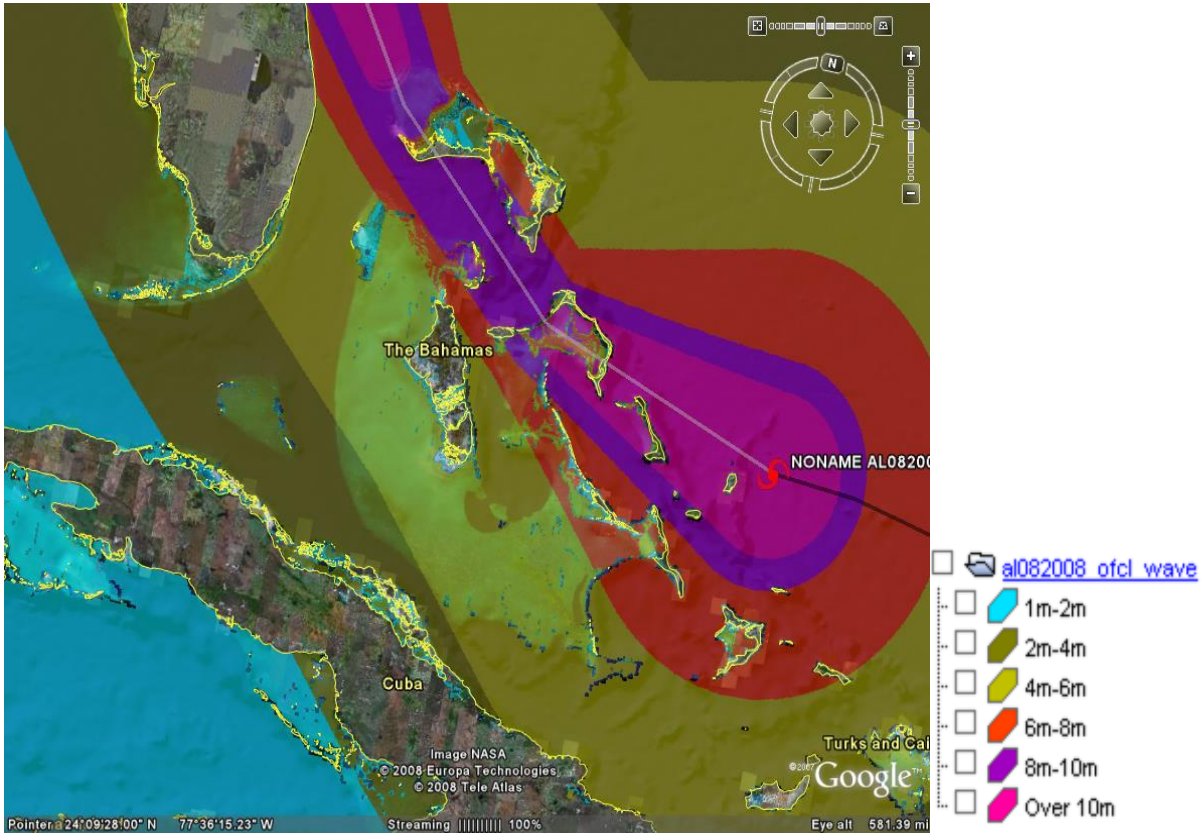


Figure 13: Wave Heights (Peak)

Q. Is there a link between the RTFS and the Dewetra system?

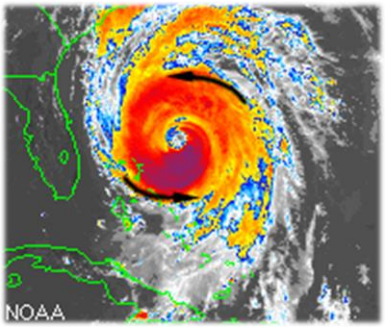
A. The RTFS is linked to the Caribbean Dewetra Platform for Natural Disaster Risk Assessment and Prediction, a regional early warning system platform. The Dewetra system was originally designed by CIMA Research Foundation on behalf of Italian Civil Protection and was tailored to Caribbean needs as part of the UNDP "Enhancing Resilience to Reduce Vulnerability in the Caribbean" project. Dewetra is a real-time data and information integration system for hydrometeorological risk forecasting, environmental monitoring and disaster risk mitigation. Its ability to integrate climate models and field observations in real time can provide strong support to meteorological analysis and forecasting in the region.

Outputs from the RTFS related to vulnerability and risk and hazard impacts are integrated into the Caribbean Dewetra platform to form the basis of the impact analysis performed by Dewetra.

Q. When is the RTFS made available?

A. The RTFS service is made available at the beginning of every Atlantic Hurricane Season which starts on 1 June or when a storm becomes active within the designated CCRIF monitoring region.

Q. At what stage in the development of a tropical cyclone is the RTFS initiated?



A. The tropical cyclone model simulation for a system is initiated as soon as the first official forecast advisory is issued by the National Hurricane Center. This is when the system is upgraded to at least a tropical depression.

Q. Can the RTFS be used to track a rainfall event?

A. The RTFS cannot track a rainfall event that is not related to a tropical cyclone. The RTFS system is specific to tropical cyclones and is initiated by storm track and intensity information from the National Hurricane Center. However, with the development of the Excess Rainfall product, the TRMM data can be used to monitor rainfall. Kinetic Analysis Corporation (KAC) has improved the TRMM data – to produce iTRMM ("improved" TRMM) data – for the Caribbean by using topography data to more accurately capture regional rainfall information.

Q. Is the RTFS relevant to earthquakes?

A. No. The RTFS is only relevant to tropical cyclones as it uses internationally-accepted forecast products from NHC. No such forecasts are possible for earthquakes as there are no proven, reliable pre-cursor signals for earthquakes.

Q. How often is the RTFS feed updated?

A. As soon as the latest storm fix (data on location, track, intensity) is received, Kinetic Analysis Corporation (KAC), the company which licenses the RTFS to CCRIF, starts modelling the storm to produce hazard footprints and impact estimates. The RTFS

feed is then updated by KAC with each storm advisory issued by the National Hurricane Center (NHC), which is generally every 6 hours. Modelling results are available within 5 minutes of latest NHC forecast.

Q. How are the RTFS data made available?

A. The RTFS data or results are provided in kml format, which can be displayed in Google Earth. This allows the user to display the map layers over the Google Earth background, which puts the hazard and impact data layers in an easy to visualise local geographic context. For best performance, users should install the latest version of Google Earth. Google Earth and tutorials on its use are available for free at earth.google.com.

Q. Can the RTFS provide countries with information on whether their CCRIF policy is triggered during the passage of a storm?

A. To some extent the RTFS can provide countries with an idea of whether their CCRIF policies have been triggered or not, as the outputs utilised in the Hazard and Loss Estimation Model underpinning policies is consistent with the hazard outputs of the RTFS. However, the triggering of a policy is not only dependent on hazard information (such as shown through the RTFS) but is also contingent on the attachment point of the policy, which is a value of dollar loss, for which there is no direct representation in the RTFS.

Q. Do regional organisations use the outputs of the RTFS?

A. Yes. The Caribbean Institute for Meteorology and Hydrology (CIMH) includes the RTFS outputs in briefings it prepares for the Caribbean Disaster Emergency Management Agency (CDEMA) during active weather systems that affect any CDEMA member states. CDEMA circulates these briefings to national disaster managers throughout the region. The event briefings include:

- Current weather scenario
- Surface weather analysis
- Review of tropical storm information
- Analysis of storm intensity and forecast based on NHC outputs
- Review of satellite and radar imagery
- Analysis of CIMH Weather Research and Forecasting model output
- Analysis of storm impacts based on RTFS outputs

Q. Who can access the RTFS?

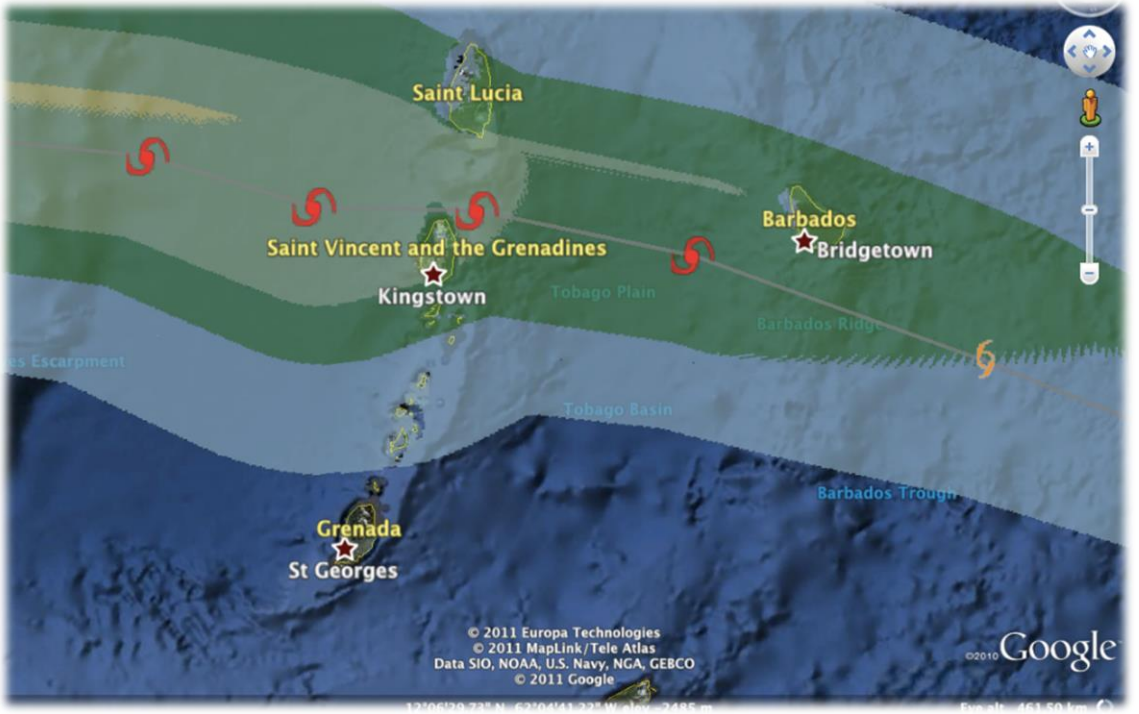
A. The RTFS was developed primarily for disaster managers and meteorology officers in CCRIF member countries. It is available to national, regional and international organisations (which are working in the Caribbean) involved in disaster management, meteorology and/or planning. To obtain an account for the RTFS, send a request to CCRIF by email. Note that RTFS outputs cannot be commercialised by any user.

Q. Is there any training available on how to use the RTFS?

A. Yes. Each year at the beginning of the Atlantic Hurricane Season (which is from June 1 to November 30 each year), CCRIF offers an online course entitled, *Understanding*

and Using the CCRIF Real-Time Forecasting System, for disaster managers, meteorology officers and other interested parties.

The training is conducted in partnership with the Caribbean Institute of Meteorology and Hydrology (CIMH), Caribbean Disaster Emergency Management Agency (CDEMA) and Kinetic Analysis Corporation (KAC). The course includes discussion of National Hurricane Center (NHC) Advisories, storm impact forecasting and a practical demonstration of the RTFS using recent storms.



Published by
CCRIF SPC

103 South Church Street
Harbour Place, 1st Floor
P.O. Box 1087
Grand Cayman, KY1 – 1102
Cayman Islands

Website: www.ccrif.org
Email: ccrif@ccrif.org
@ccrif_pr
www.facebook.com/ccrif.org