CCRIF

The Caribbean Catastrophe Risk Insurance Facility

Understanding CCRIF

Answers to Frequently Asked Questions

Revised November 2013

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About this Book

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

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) was formed to provide short-term funding to support relief in the immediate aftermath of a natural disaster. CCRIF is the world's first multi-country, multi-peril risk pool providing parametric insurance and was designed to limit the financial impact of catastrophic hurricanes and earthquakes by quickly providing short-term liquidity when a policy is triggered.

This book provides answers to questions frequently asked by persons who wish to learn more about CCRIF and its products and services. It is an update to the publication, "A Guide to Understanding CCRIF – A Collection of Questions and Answers".

Background on the Caribbean Catastrophe Risk Insurance Facility (CCRIF)

Q. What is the Caribbean Catastrophe Risk Insurance Facility?

A. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is the first multi-country risk pool in the world, and is also the first insurance instrument to successfully develop parametric policies backed by both traditional and capital markets. It is a regional catastrophe fund for Caribbean governments designed to limit the financial impact of devastating hurricanes and earthquakes – and now excess rainfall – by quickly providing financial liquidity when a policy is triggered.

CCRIF was developed under the technical leadership of the World Bank and with a grant from the Government of Japan. It was 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.

CCRIF was created 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 launched in 2007 and structured as an insurance instrument to provide coverage similar to business interruption insurance in the event of losses from tropical cyclones or earthquakes.

Similar to a mutual insurance company, CCRIF is operated on behalf of sixteen current participating states in the Caribbean, each of which pays a 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 or earthquakes) within a given year. By pooling their 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

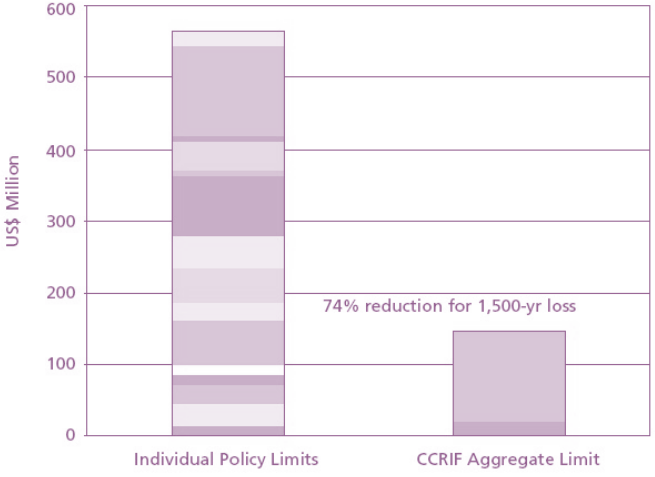


Figure 1: Insurance Costs

what it would cost if countries were to purchase identical coverage individually compared with buying the coverage from CCRIF.

Sixteen governments are currently members of the Facility: 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.

The Facility 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 who are not participants in the Facility's insurance program, and is nominated by the Caribbean Development Bank (CDB); one representative for participants 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. 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.

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.

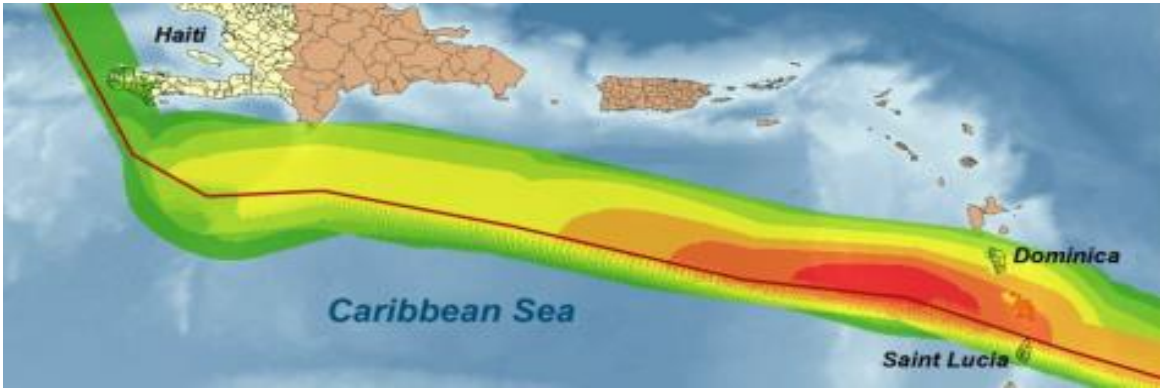
Q. What does CCRIF's Strategic Framework look like?

A. **CCRIF's Vision:** A Caribbean region with optimised disaster risk management and climate change adaptation practices supporting long-term sustainable development

CCRIF's Mission: To assist Caribbean governments and their communities in understanding and reducing the socio-economic and environmental impacts of natural catastrophes. We do this by providing immediate liquidity through a range of affordable insurance products, developing innovative and dynamic tools and services, and operating in a way that is financially sustainable and responsive to the needs of the region

CCRIF's Strategic Objectives: To provide products, services and tools responsive to the needs of the region; to enhance capacity for disaster risk management and climate change adaptation; to sustain corporate and financial integrity; and to deepen understanding and knowledge of catastrophe risk and the solutions CCRIF provides

The CCRIF Model



Q. **How does CCRIF work?**

A. CCRIF is able to provide insurance that is affordable to its members. CCRIF aggregates disaster risks across the Caribbean, achieving the kind of risk diversification and spreading that its members are not able to attain on their own. By pooling countries' risks into a single diversified portfolio, CCRIF is able to provide insurance at the minimum price possible. It has been estimated that insurance obtained through CCRIF is about half the cost of coverage a member country could obtain on its own. For CCRIF policies, each country pays a premium directly related to the amount of risk it transfers to CCRIF.

CCRIF was designed to retain some risks of member governments and to transfer part of its risk to the traditional reinsurance markets and to the capital market via a risk swap between CCRIF and the World Bank Treasury. This was the first time such an instrument was used to transfer risk from a national catastrophe pool and reduced the cost of the capital that CCRIF needed to cover its risk. The Facility operates within a strong sustainability

framework which sees it capitalised significantly above established national benchmarks for catastrophe insurers.

These insurance policies disburse funds based on impact and loss estimated within a catastrophe risk model – without having to wait for a post-event on-site loss assessment. 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.

Q. Why parametric insurance?

A. The selection of a parametric instrument as a basis for the CCRIF policies was largely driven by the fact that parametric insurance is generally less expensive than an equivalent traditional indemnity insurance product as it does not require a loss assessment procedure in case of a disaster. Parametric insurance also allows for claims to be settled quickly. This is an important feature considering the urgent need for liquidity after a catastrophe. In addition, the instrument is also less exposed to moral hazard and adverse selection problems (which are costly to monitor) because the cost of insurance can be immediately related to the probability of an event, and the payout is independent of any mitigation put in place after the policy is issued.

Despite these benefits, parametric products are exposed to basis risk, i.e., the possibility that a payout may be higher or lower than actual losses. Although

this is a significant challenge in terms of the development of the instrument, careful design of input parameters and the loss model as undertaken by CCRIF helps reduce the basis risk. Furthermore, as large institutions, governments are better able to accommodate basis risk than, say, individuals.

It should be noted that CCRIF's risk-based pricing of parametric policies means that premium costs cover just the parametric losses, and would be substantially higher if they had to cover actual losses, despite there being an equal possibility of 'winning' or 'losing' on the basis risk issue. CCRIF policies are thus financially highly efficient regardless of the basis risk issue.

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

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 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.

In developing the exposure module, the exposure values of "assets at risk" are estimated from available secondary data sources (including economic 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-km grid square across the entire country in question.

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 (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) intensity is called a vulnerability function. Each asset class has a different vulnerability function for each hazard.

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.

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. In the CCRIF catastrophe risk model, where are the base numbers for population from and what is the accuracy of the system in trials?

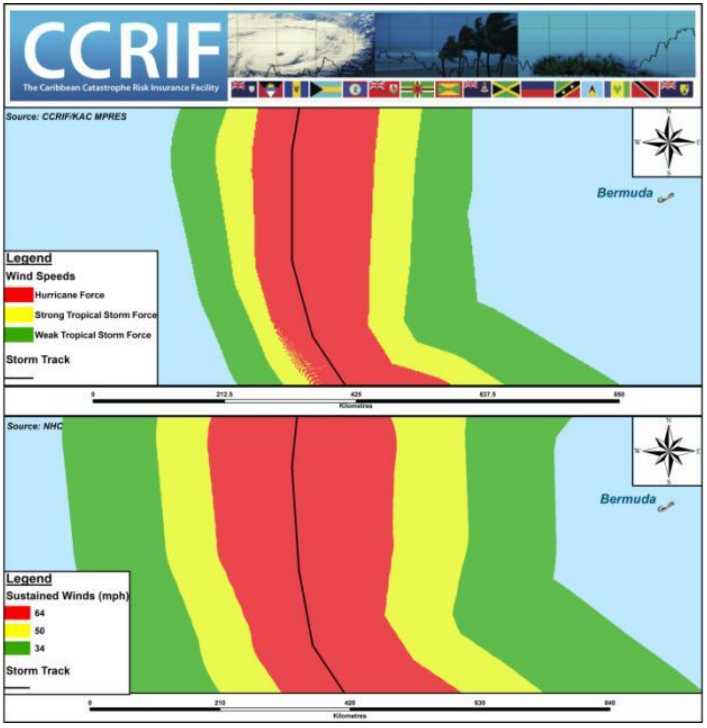
A. The population data is taken from the LandScan data source. LandScan is a satellite-derived database together with a statistical database which is compiled by several US agencies and it provides the total population count by country as well as the distribution of that population over the terrain of 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.

In terms of CCRIF's storm impact estimates, CCRIF verifies systematically how the estimates stand up once the storm is completed since an estimate based on numerical modelling can never be an exact representation of what is going to be observed in a country.

After the passage of every tropical cyclone that affects a member country, the Facility invests significant amounts of time in terms of collecting information to verify the models which 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 that 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) the Caribbean Institute for Meteorology and Hydrology (CIMH) post-event reports etc. and also 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. Note that 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, how many houses were partially destroyed, how many people were affected, what is the total damage to the schools, total damage to the 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 really be exact numbers – but that there is also uncertainty associated with numbers on the ground.



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 is a direct function of the amount of risk being transferred, ensuring no cross-subsidisation of premiums and a level playing field for all participants.

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 hazardous event and the distribution and exposure of national assets at risk relative to the hazard footprint (as described above). The initial payout trigger level (at the attachment point or above the deductible) specified in the policy/contract is then applied to the modelled government loss. The policy is triggered when

the modelled loss for a hurricane or earthquake in a member country equals or exceeds the attachment point (deductible) specified in the policy contract.

Q. How are payouts calculated?

A. In the case of hurricanes, 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 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.

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.

Once a loss is calculated in the model for a given country (which is designed to replicate as closely as possible the losses felt on the ground), the specific payout totals are based on the level of coverage a country has. Each individual country chooses its own coverage options in terms of the attachment point (deductible), exhaustion point (which determines the 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. Since its inception in 2007, CCRIF has made eight payouts totalling US$32,179,470 to seven member governments. All payouts were available to be transferred in full to the respective governments two weeks after the event and in three cases, interim payments were requested and made one week after the event. These payouts are shown in the table below.

Event	Country Affected	Payouts (US$)
Earthquake, 29 November, 2007	Dominica	528,021
Earthquake, 29 November, 2007	Saint Lucia	418,976
Tropical Cyclone Ike, 2008	Turks and Caicos Islands	6,303,913
Earthquake, 12 January, 2010	Haiti	7,753,579
Tropical Cyclone Earl, August 2010	Anguilla	4,282,733
Tropical Cyclone Tomas, October 2010	Barbados	8,560,247
Tropical Cyclone Tomas, October 2010	Saint Lucia	3,241,613
Tropical Cyclone Tomas, October 2010	St. Vincent & the Grenadines	1,090,388
Total for the Period 2007 - 2013		**US$32,179,470**

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. The CCRIF payout is based on the modelled loss estimate from the storm as it happens. CCRIF runs the storm track and characteristics in the loss model after the storm has affected the country and

computes all losses. That loss estimate then is used in the policy framework to determine if a policy has been triggered or not.

Q. What is the strength of winds that cause a 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.

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.

Q. Are the risks tailored for countries based on individual country hazard assessments?

A. 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. Through this mechanism, CCRIF generates very detailed hazard information for each country (actually 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 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, once the attachment and exhaustion points are selected, is tied to the ceding percentage, which in turn 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 policy holder, in CCRIF's case the specific country, covers all losses below the attachment point for any event.

The attachment point applies equally to each individual storm or earthquake. There is no accumulation of attachments (deductibles) from loss events for which the modelled loss was less than the attachment point. As the modelled loss increases above the attachment point, the corresponding payout increases up to the exhaustion point (see below for exhaustion point).

For example, an attachment point selected at the 1-in-15-year loss level 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, 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. For the 2013-2014 policy year, for example, CCRIF member countries selected exhaustion points equivalent to between 1-in-75 and 1-in-250 year events. 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 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 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 or earthquake). 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.

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. More specifically, a member country's premium cost is directly linked to the number and size of payouts that country is likely to receive in the future, averaged over a long period of time. So for each premium dollar paid by each country in the pool, each will get the exact same proportion of that dollar back in payouts when averaged over time.

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. Are countries purchasing adequate coverage?

A. CCRIF believes that adequate coverage would be 20 to 25% 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% in each of the first three years; offering premium rebates after claims-free years; and allowing access to premium financing from countries' participation fees (a one-time payment made when each country became a member of CCRIF).

Q. Does CCRIF make payouts for accumulated rainfall?

A. The risk modelling for CCRIF's hurricane coverage does not include rainfall over land as a factor that can contribute to loss. It is well known that this can be a very big factor but rainfall impacts and flooding are extremely difficult phenomena to model if there is not a very extensive rain gauge network or stream flow network and/or if the vulnerability of the infrastructure that is at risk from flooding is not known.

However, for policy year 2013/2014, CCRIF has added the new excess rainfall (XSR) product to its portfolio of offerings to Caribbean governments. This product specifically covers extreme rainfall events, from both cyclonic systems and from non-cyclonic systems. Enhancement of this product so that

it is suitable for the larger Central American countries is planned to enable launch of a product in Central America in 2015.

The Caribbean XSR model was developed after CCRIF member countries and other Caribbean stakeholders expressed a strong interest in having coverage available for excess rainfall. This parametric product was developed in collaboration with Swiss Re and is based on available NASA-processed satellite rainfall data. It has been designed as a rainfall hedge rather than replicating actual loss from the various hazards related to heavy rainfall.

The excess rainfall product is triggered independently of the current tropical cyclone product, and if both policies trigger then two separate payouts would be due. The current tropical cyclone policy is linked to wind and storm surge damage in a defined tropical cyclone. While the excess rainfall product can be triggered for a tropical cyclone, it can also be triggered in non-cyclonic systems if the rainfall trigger thresholds are met.

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. CCRIF is a regional insurance fund for the governments and it is specifically targeted at providing liquidity coverage for governments. It is a parametric insurance instrument which is not similar to indemnity type products that are usually offered by the traditional insurance companies. It also operates at a very different level from insurance companies because CCRIF is a regional institution and it is specifically targeted at governments. Therefore, it does not make coverage available for private companies, etc.

Q. In light of the fact that CCRIF is a non-profit organisation, what would happen if CCRIF is unable to make payments based on claims made which are more than the amount of funds available if there were events in a number of countries?

A. The Facility has done an extensive amount of financial modelling work 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 the Facility 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 some massive catastrophes occurring in a number of the large economies across the

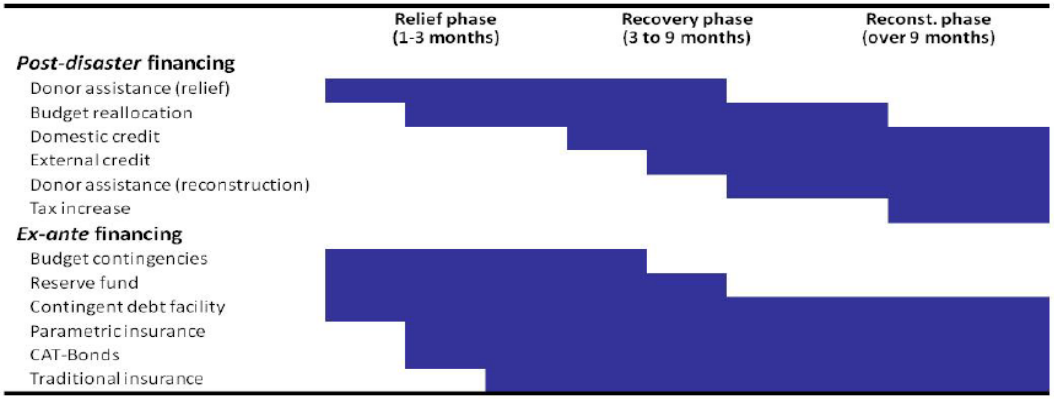
region: for example Jamaica being hit, as well as Barbados, Trinidad, Cayman and Bahamas within a given year. This is of course a possibility but CCRIF has tried to include or incorporate within the financial aspects of the Facility the ability to actually satisfy those claims. If claims from member 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. It should be noted, however, that CCRIF is owned by a Trust of which the effective ultimate beneficiaries are the CCRIF member countries, so it may be that full drawdown of all capital from CCRIF is not considered by the members to be in the best interests of the region.

For the Central American (CA) countries, a separate Trust will own the assets of the CA pool, so the same principles will apply. It is noted that huge claims in the Caribbean would not be able to draw capital from the CA pool and likewise, huge claims in Central America would not deplete the Caribbean capital.

CCRIF and Disaster Risk Management & Comprehensive Disaster Management

Q. Should CCRIF policies be used in conjunction with other disaster risk management strategies?

A. Definitely. CCRIF provides options for managing a portion of the identified risk, but CCRIF's parametric insurance policies should not be viewed as a panacea. Other financial mechanisms can and should be implemented alongside risk transfer to provide a comprehensive sovereign risk financing strategy which best balances budgetary conditions with the need to manage the ongoing economic liability which natural disasters present.



While risk transfer 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, it is important to note that this should be accompanied by risk mitigation (or reduction) activities to reduce vulnerability to natural hazards (and thus preventing them from becoming "natural disasters").

There are social conditions that countries in the region need to address to reduce their vulnerability to natural hazards - for example, rapid and unplanned urban expansion, the growth of informal settlements in locations on steep hill-slopes and river banks, low level of use of environmental impact assessments (EIAs) and strategic environmental assessments (SEAs) and inadequate development planning, standards, building codes as well as poor enforcement of regulations and standards.

Both risk mitigation and risk transfer should be part of a country's comprehensive disaster management (CDM) strategy. 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 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. Each country must decide the proportion of its risk management portfolio which should be based on risk mitigation and on risk transfer.

Q. Is CCRIF engaged in any other activities towards expanding risk transfer options in the region?

A. Currently, CCRIF is working with private sector stakeholders to provide coverage for individuals – as opposed to national governments. The Facility is working with the Munich Climate Insurance Initiative (MCII), MicroEnsure and MunichRe on the Climate Risk Adaptation and Insurance in the Caribbean Project, which is supported by the German Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU). This project 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 presents an opportunity to operationalise coverage for tail events and limit burden placed on the state.

The overall aims of the programme are to:

- overcome barriers and catalyse solutions to address middle-level weather-related risks (return periods of 10-20 years) and facilitate public safety nets and public-private insurance solutions for vulnerable people;
- find ways to link these insurance solutions to DRR for catalytic adaptation benefits; and
- demonstrate the value of a regional facility for achieving these aims.

Two products are being developed in three pilot 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. Both Saint Lucia and Jamaica have already launched this product.
- 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.

Q. Could the CCRIF mechanism, and other regional risk pools which could be set up in a similar way, be expanded to enable developing nations to manage a larger portion of their natural hazards risk through mutual pools?

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, to help manage those risks of climate change that cannot easily or cost-effectively be adapted to.

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 (TA) 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. The Facility is actively involved in supporting the region in CDM efforts through partnerships with key regional organisations (for

example, CCRIF has memoranda of understanding with CDEMA, CIMH, CCCCC, UWI, OECS, IDB and UNECLAC[1]), 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.

The TA programme also includes the provision of scholarships to Caribbean students to study at UWI and outside the region in areas related to disaster risk management. Since 2010, CCRIF has provided 20 scholarships valued at over US$240,000.

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

A. Yes. Caribbean leaders and decision makers have recognised the need for sound quantitative data to support the development of national climate 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[2],

[1] Caribbean Disaster Emergency Management Agency, Caribbean Institute for Meteorology and Hydrology, Caribbean Community Climate Change Centre, University of the West Indies, Organisation of Eastern Caribbean States, Inter-American Development Bank and UN Economic Commission for Latin America and the Caribbean

[2] 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 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 innovation of the ECA methodology lies in its positioning across different knowledge sectors, spanning climate science, the financial industry and economic research (ECA Working Group, 2009). The analysis is based on joining four main elements:

- Climate change scenarios based on the most recent available scientific evidence
- Hazard models forecasting the occurrence of hurricanes or other damaging events
- Economic damage functions linking the intensity of events to economic impact
- Value distribution models describing each country's economic and population exposure to hazard in a granular, precise way

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 Caribbean Community Climate Change Centre and UN Economic Commission for Latin America and the Caribbean, with analytical support provided by McKinsey & Company and by Swiss Re, who developed the loss assessment model.
The first phase was conducted in eight Caribbean countries: **Anguilla, Antigua & Barbuda, Barbados, Bermuda, the Cayman Islands, Dominica, Jamaica and Saint Lucia.**
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

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. Key findings of the ECA Study for the eight pilot countries were:

- Current climate risk is already high, with expected losses of up to 6% 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% of the expected damage by implementing cost-effective adaptation measures.
- A balanced portfolio of risk mitigation and risk transfer measure will be needed.

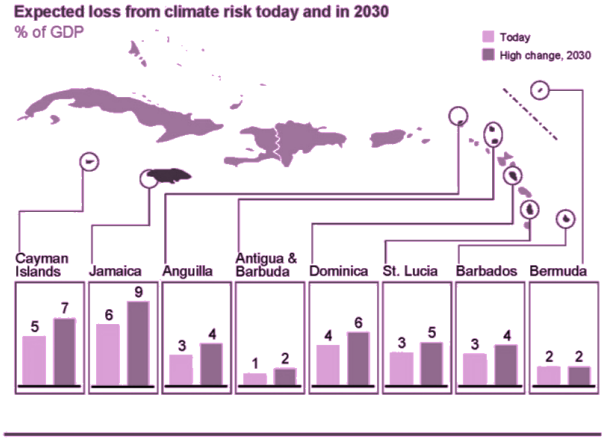
Among the hazards considered, hurricane-induced wind damage is deemed to have the largest damage potential, accounting for up to 90% of the overall damage. The contribution of coastal flooding/storm surge to total damage is higher in low-lying countries. In the Cayman Islands, for example, coastal flooding/storm surge accounts for about 45% 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% as a consequence of the expected rise in sea surface temperature in the hurricane genesis region.

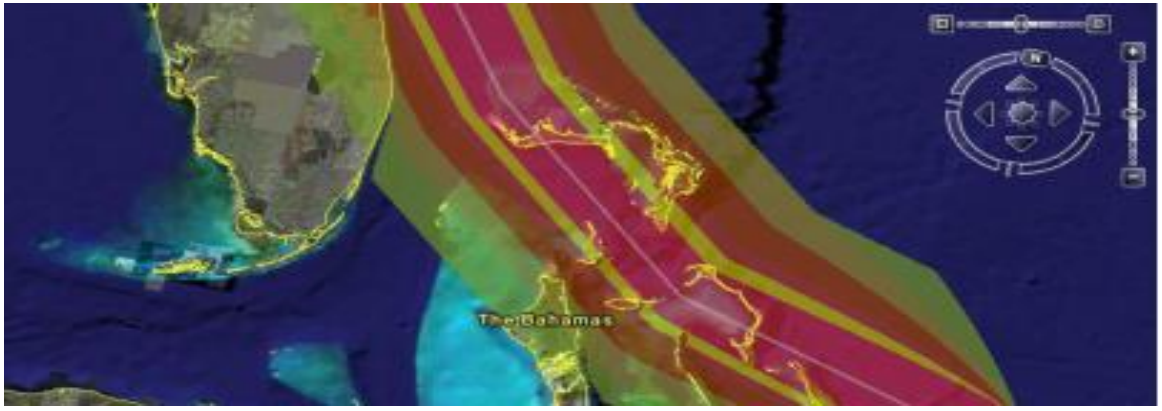
The Study concluded that overall, expected loss as a proportion of GDP could rise to between 2% and 9% in the high climate change scenario by 2030. In absolute terms, expected loss may triple between now and 2030, with wind remaining the single largest contributor. Economic growth is typically the

greatest driver of the rise in expected loss, accounting for some 60% of the increase in all countries, with the exception of Jamaica, where it accounts for approximately 40%.

The Study also stated that some countries can avoid up to 90% 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.



CCRIF Real-Time Forecasting System (RTFS)



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 are the benefits of the Real-Time Forecasting System? What is the purpose of the RTFS?

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 below:

Contingency Planning

- Use the TAOS information to obtain a preview of what might happen if a given storm continues along its projected path, and activate appropriate contingency plans based on this insight
- Update country plans as needed with new information from latest forecast

Shelter Management

- Identify impact areas and shelter locations to support shelter allocation decision
- Identify potential damage to shelters, and plan for alternatives

Emergency Interventions

- Identify areas where population is at risk and issue warnings, plan for assistance

Q. What are the operational steps involved in producing detailed information on the expected hazard levels and their impacts from tropical storms?

A. To forecast hazard intensities and their impact for each active storm, the following processes are active on a 24/7 basis:

- Gathering and processing of the National Hurricane Center (NHC) and ATCF data: with each new storm advisory release, the current position, intensity data and forecast track are extracted. The storm model is then initiated with this information. If more than one storm is active at a time, separate job files are created and run for each new separate storm.
- Detailed modelling of expected land impact: the model simulates the active storm, producing forecasts for the intensity of wind, wave, storm surge and cumulative rainfall along the storm track, using global terrain models.
- Graphic and GIS dataset generation: upon completion of the model runs, the results are converted to graphical map form and datasets. The map images in Google Earth (kml) format will then be made available in the secure member area on the CCRIF website, where the GIS datasets can also be posted for download by members. Members will be alerted of the availability of the new maps and data by an automated email message.

Q. What are the key features of the RTFS?

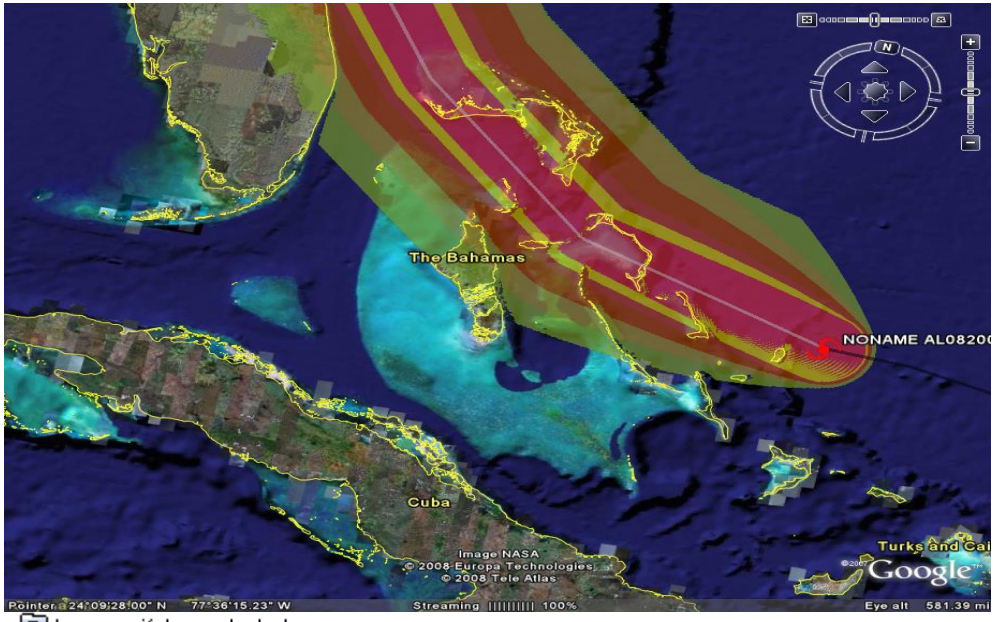
A. For all active tropical storm systems, RTFS computes the intensities of the storm hazards along the forecasted track, and the potential impact of those hazards on affected territories. This information is updated with each storm advisory issued by the National Hurricane Center (NHC). The storm modelling 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 2, 3 and 4 below are footprint maps of wind speed, storm surge height (peak) and wave height (peak) for various storms.

Figure 2: Wind Speeds (Maximum)



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 3: Storm Surge Heights (Peak)

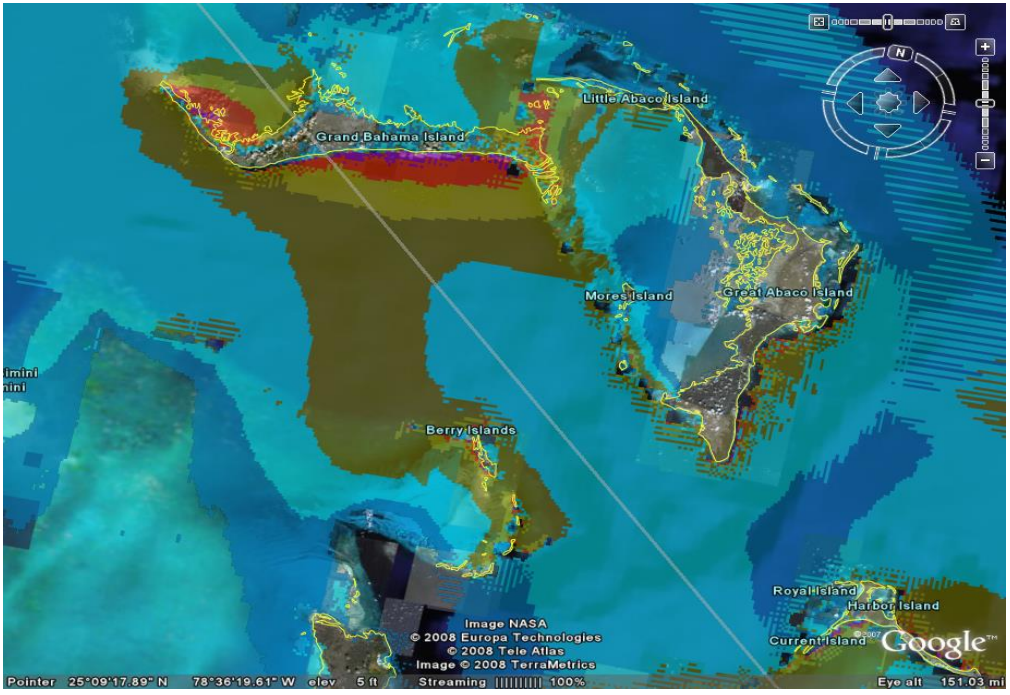
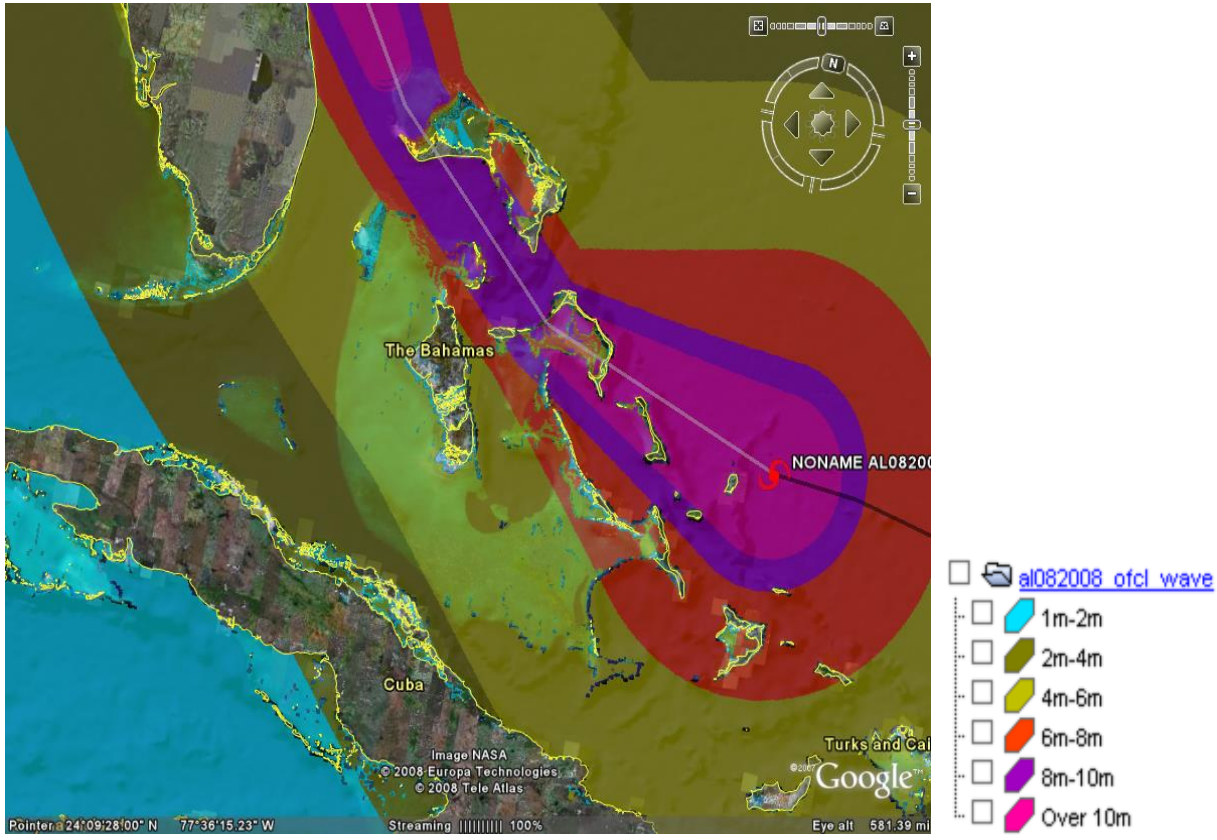


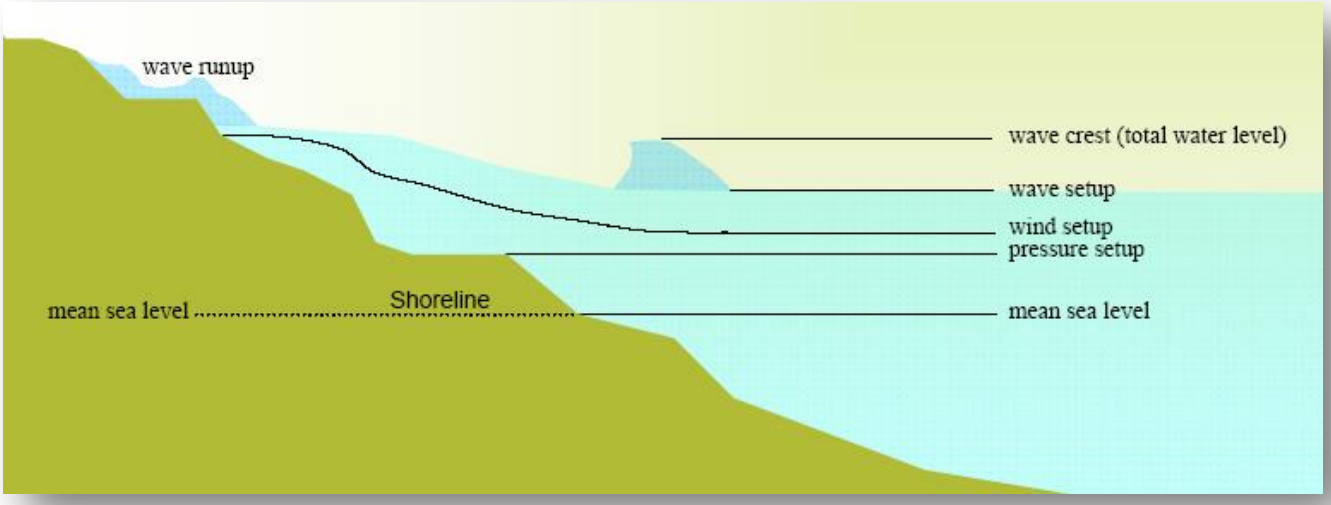
Figure 4: Wave Heights (Peak)



Q. What are the definitions of the various RTFS hazards?

A. The RTFS definitions include the following:

- Wind speed: two-minute average wind speed at 10m above terrain. These wind speed estimates are compatible with the Automated Surface Observing System (ASOS)
- Wave height: measured from crest to trough
- Storm surge: elevation above mean sea level or terrain height. Surge height includes astronomical tides, wind setup, pressure setup and wave setup, but not wave runup (see diagram below)



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. 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. 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. How are the storm hazard and basic impact data provided?

A. Results are provided in a kml format which can be displayed in Google Earth, which allows for easy visualisation within a local geographic context. The map layers containing the hazard and impact data are made available in hazard and impact forecast files which are organised within three folders, each of which contains multiple map layers showing the following:

- Storm current position [folder name: taos_carib_ofcl_storms_kml] – this folder contains three subfolders for each storm:
    1. Official track — the storm track as forecasted by the NHC. Storm information, such as the storm name, date and time, wind speed and central pressure are made available;
    2. Past positions — locations occupied by the storm centre for each of the past forecast times; and
    3. Forecast positions — future positions as forecasted. For each position forecast details include the date and time of the forecast, the expected storm wind speed, and the hours out from current location.

- Storm hazard estimates [folder name: taos_carib_ofcl_hazards_kml] – this folder contains five subfolders for each active storm:
    1. Wind speed —maximum wind speed, grouped by Saffir-Simpson category;

2. Storm surge — maximum storm surge height; over water, this height is measured above Mean Sea Level and over land it is measured above the terrain height;
3. Wave height — maximum wave height, measured crest-to-trough;
4. Total rainfall — cumulative rainfall over the duration of the storm forecast, since the first forecast for this storm; and
5. Impact of wind forces — qualitative wind effects, based on the Beaufort scale.

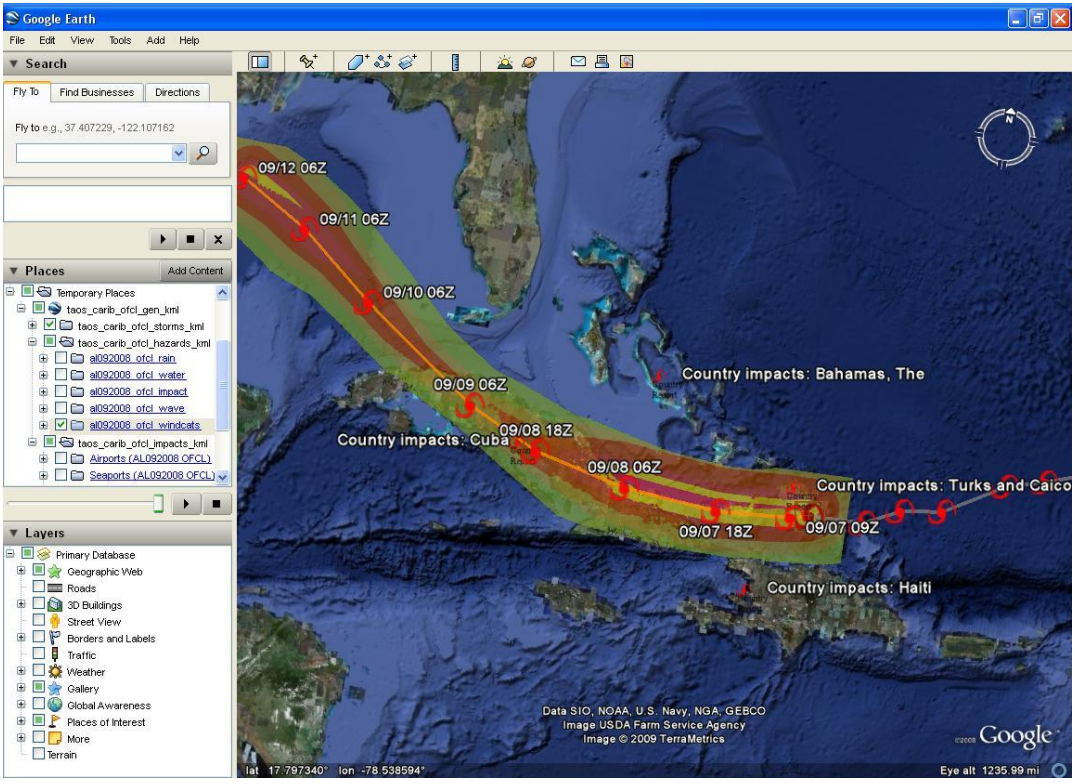
It is important to note that the maximum hazard intensities shown in one map layer do not occur simultaneously; they are attained at different times during the progress of the storm along the track.

- Territory impact estimates [folder name: taos_carib_ofcl_impacts_kml] - this folder contains two subfolders for each active storm:
    1. Impact on port and airport facilities — operations downtime in number of days, and potential damage level
    2. Impact on population — tabular estimates of the population affected by the different levels of wind hazard, and by flooding. A sample population impact report is shown below

Hazard and impact information is provided for all active storms in the Atlantic and, starting in 2014, the Eastern Pacific for which official forecasts are disseminated by the NHC. Names for individual map layers and folders within these three primary folders identify the map feature and the storm responsible for the hazards and impacts shown.
KAC uses the unique ID assigned through the Automated Tropical Cyclone Forecasting (ATCF) system to identify each storm. The ATCFID is in the form 'ALxxyyyy', where 'AL' denotes the Atlantic basin, 'xx' is the sequential number of the storm in the season, and yyyy the current year.

Should more than one storm be active in the monitoring area at one time, the separate storm-specific layers allow hazard and impact information for each storm to be displayed separately or simultaneously in Google Earth.

The image below shows selected results from a sample storm, including the qualitative wind impacts and the current and forecast positions of the storm.



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