CCRIF

The Caribbean Catastrophe Risk Insurance Facility

CCRIF/SWISS Re Excess Rainfall Product

A Guide to Understanding this New Product

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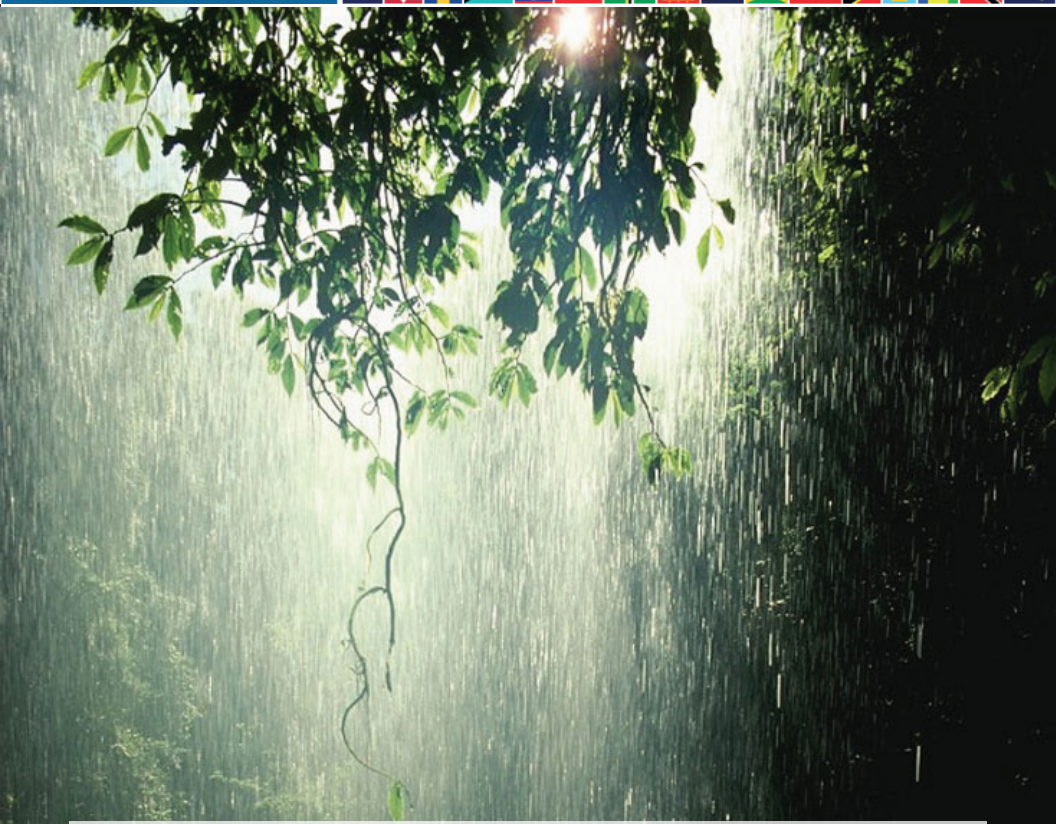

CCRIF/Swiss Re Excess Rainfall Product

A Guide to Understanding the CCRIF/Swiss Re Excess Rainfall Product

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About the Caribbean Catastrophe Risk Insurance Facility

Vision Statement

A Caribbean region with optimised disaster risk management and climate change adaptation practices supporting long-term sustainable development

Mission Statement

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

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 by quickly providing financial liquidity when a policy is triggered. CCRIF was developed through funding from the Japanese Government, and 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.

Sixteen governments are currently members of the Facility: Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, St. Vincent & the Grenadines, Trinidad & Tobago and Turks & Caicos Islands.

CCRIF 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.

Since the inception of CCRIF in 2007, the Facility has made eight payouts totalling US$32,179,470 to seven member governments. All payouts were transferred to the respective governments less than a month (and in some cases within a week) after each 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, September 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 and the Grenadines	1,090,388
Total for the Period 2007 - 2011		**US$32,179,470**

Picture form the 2010 Atlantic Hurricane Season which was well above average, with nineteen named storms including twelve Hurricanes. This increased activity in the Caribbean Basin led to member countries experiencing nine reportable events, with four policies being triggered as a result of two of these storms - Tropical Cyclones Earl and Tomas. Total payments made by CCRIF were over US$ 17 million.

Background

Since 2008, CCRIF has been engaged in research towards the development of an excess rainfall product for the Caribbean Region. This has been in direct response to the interest expressed by many CCRIF participating countries and stakeholder partners in making available catastrophe flood coverage. The CCRIF/Swiss Re Excess Rainfall (XSR) Product has been developed to address some of the losses associated with heavy rain. The product is aimed primarily at extreme high rainfall events of short duration (a few days).

This XSR product is underpinned by parametric estimation of the impacts of heavy rain using the following inputs:

- Rainfall from satellite data (historical to estimate
- probabilities/pricing and real-time to calculate
- estimated index losses and payouts)
- Exposure from the CCRIF Multi-Peril Risk Estimation
- System (MPRES) database
- Vulnerability using empirical fitting of historical impact information

Despite research commencing in 2010, there had been some delay in the launch of the excess rainfall product, primarily due to the complexity of the development of the product itself. The CCRIF/Swiss Re XSR product, to be launched by the end of 2012, will add to the portfolio of catastrophe insurance products available to Caribbean countries.

Delay in bringing the excess rainfall product to market was due to methodological difficulties and in part to capacity constraints. The main issues were:

- Rainfall is perhaps the most difficult area of weather and climate modelling and there exists no scientific consensus on a methodology to underpin excess rainfall coverage.
- Initiating the project during 2008–2009 and continuing into the 2009–2010 policy year KAC tested three extant methodologies building on them to develop and begin vetting a refined methodology with the reinsurance community.
- The paucity of historical rainfall data series contributed to the delays.
- The product will be a new and untested product as it is the first time this is being done and it took time for reinsurers to get comfortable with the policies and the risk involved.

Rationale for an Excess Rainfall Product for the Caribbean Region

An Economics of Climate Adaptation Study in the Caribbean led by CCRIF in collaboration with other partners revealed that:

- Natural hazards already represent a significant risk to inhabitants and economies in the Caribbean. Annual expected losses from wind, storm surge and inland flooding amount to up to 6% of GDP in some countries. Climate change has the potential to greatly exacerbate these risks, and could increase expected losses by 1 – 3 percentage points of GDP by 2030.
- Climate change will have an impact on local sea levels, hurricane intensity, precipitation and temperature patterns

The study further stated that numerous adaptation measures are available to decision makers to respond to the growing threat of climate change. The results of the Study further indicated that these adaptation measures can be organised into two broad groupings - risk mitigation and risk transfer - and depending on each country's characteristics, risk mitigation initiatives can cost-effectively avert up to 90% of the expected loss in 2030 under a high climate change scenario. It further stated that risk transfer or insurance measures also play a key role in addressing the financial consequences of low-frequency, high-severity weather events and can be used to limit the financial impact for people and assist in extreme events. These changes in climate, particularly hydrometeorological events, will have an increasing impact on the Caribbean basin.

Whilst CCRIF's insurance cover has been extremely beneficial in the event of hurricanes and earthquakes, CCRIF member governments and some non-member countries (for example Guyana) still have significant exposure to floods. Many nations have stated that they view a flood or excess rainfall product as essential. Also, CCRIF participating countries and stakeholders have continued to express a strong interest in having available coverage for excess rainfall, both within hurricanes and in non-hurricane systems. In fact, a Beneficiary Assessment of CCRIF undertaken by the World Bank in 2010, revealed that 94% of respondents felt that CCRIF should cover other hazards, including flooding. It is for these reasons that CCRIF is launching a new insurance product to cover extreme rain events.

Developing the Excess Rainfall Product – A CCRIF/Swiss Re Collaboration

As stated previously, the excess rain model was developed after CCRIF participating countries and stakeholders expressed a strong interest in purchasing catastrophic flood coverage.

Between 2009 and 2010, CCRIF contracted the services of the Caribbean Institute of Meteorology and Hydrology (CIMH) and Kinetic Analysis Corporation (KAC) to develop a synthetic numerical rainfall model. During an extensive review process of this model, CCRIF decided that the CIMH/KAC model required further testing before it could be used to underpin a parametric insurance product.

As a result of this development, the Facility reviewed different options and decided to begin collaboration intensely with Swiss Re, a leading global reinsurer, in 2011 to develop the first iteration of a parametric excess rainfall product. This was undertaken with the expectation that the CIMH/KAC model would eventually be used to support a second iteration of the excess rainfall product, thereby making the product even more robust and in keeping with CCRIF's approach of continuous improvement.

Through the combined technical expertise of CCRIF and Swiss Re, and drawing on public data, CCRIF is now able to offer excess rainfall coverage to its members and looks forward to providing coverage throughout the Caribbean.

The CCRIF/Swiss Re Excess Rainfall Model

The CCRIF/Swiss Re XSR model is simpler than the CIMH/KAC model and has been developed as a starting point in meeting the needs of CCRIF's client countries as well as other countries in the Region. In the future, changes and improvements are expected to be made to this first iteration of the excess rainfall product as the CIMH/KAC work reaches the stage where it can provide complementary input rain data to the CCRIF/Swiss Re dataset.

The CCRIF/Swiss Re XSR model is based on 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 (JAXA). TRMM provides a satellite-based estimate of aggregate rainfall at quarter-degree (~25km) resolution every 3 hours.

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 and a very high degree of dependability as it is sourced directly from NASA.

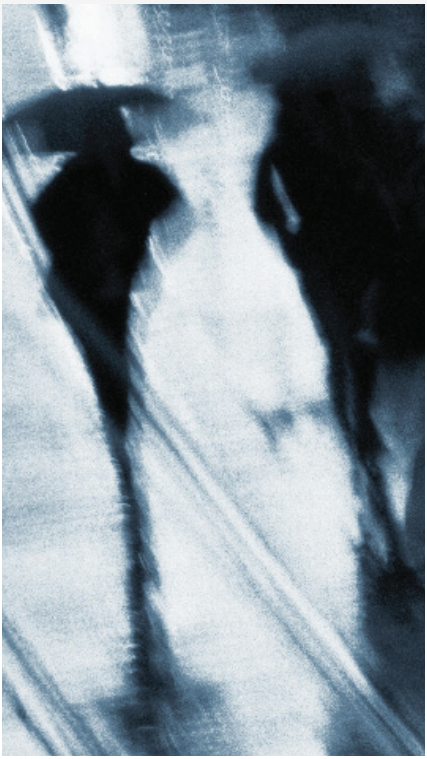
The XSR model uses the TRMM data to compile a 5-day running aggregate of rainfall measurements at all of the TRMM grid nodes across a country. As used in other CCRIF products, the Multi-Peril Risk Estimation System (MPRES) exposure database is utilised to map exposures across a country at 30arcsecond (~1km) resolution.

Remote sensing data, economic and demographic statistics for 2010 were used to generate the exposure database. The database is designed to provide acceptable estimates for losses to physical assets from hydrometeorological and geophysical hazards.

Since the TRMM nodes are at ~25km resolution, the 1km MPRES exposure data are mapped onto the TRMM grid. This provides a distribution of the total MPRES values between the rainfall measurement points covering each country. For scaling purposes, 1% of the total MPRES exposure value is used as the base XSR exposure.

Calculating Index Losses

To calculate index losses for both historical and real-time analyses, a 5-day aggregate rainfall is calculated for each TRMM grid node using a moving window, which ensures that peak measurements are captured. A rainfall event occurs when the 5-day aggregate exceeds 50mm and ends on the day before rainfall next falls below 50mm. Events are logged for each TRMM measuring point. For each event at each TRMM grid node, the single highest 5-day aggregate rainfall measurement is used to calculate the index loss rate via a vulnerability curve which maps loss percentage to rainfall amounts.



The indemnity rate for each event is applied to the exposure value of the TRMM grid node, to give the individual index loss for the event for the grid node. To calculate the national index loss, the individual index losses at each grid node are added together each day. National-level events are defined as continuous periods where there is an ongoing event at one or more TRMM grid nodes. Therefore, once an event occurs at one or more of the TRMM grid nodes, a national loss is assigned to it with the date of the last day of the event as the event identifier. Also, national losses are aggregated on an annual basis, thus allowing coverage to be offered on a per-event or on an annual aggregate basis at the national level.

Calculating Index Losses

5-day aggregate rainfall is calculated for each TRMM grid node (rainfall measuring point) using a moving window to ensure that peaks are captured

For each measuring point, a rainfall event starts when the 5-day aggregate exceeds 50mm and ends on the day before rainfall next falls below 50mm

For each event at each TRMM grid node, the single highest 5-day aggregate rainfall value is used to calculate the loss rate via the vulnerability curve

The loss rate for the event is applied to the exposure value of that TRMM grid node

To calculate national index loss, individual TRMM grid node losses are added together each day

National-level events are defined as continuous periods where there is an ongoing event at one or more TRMM grid nodes

Calculating National Index Losses

National losses are all assigned to events, with the date of the last day of the event as the event identifier

National losses are also aggregated on an annual basis

Coverage can thus be offered on a per-event or an annual aggregate basis at the national level

Country Rainfall Risk Profiles

Rainfall risk profiles are being produced by CCRIF for all its current members as well as for Guyana, Montserrat, Suriname and the British Virgin Islands. These four non-member countries will be provided with the opportunity to purchase the excess rainfall product. The rainfall 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.

Each country's rainfall risk profile contains information such as:

- General rainfall characteristics of the country, including monthly and annual rainfall averages as well as single day, 3-day and 5-day maximums for the 14-year TRMM record
- Excess rainfall product model description including the country's excess rainfall exposure distribution as well as presentation of the vulnerability curve
- Model results of the 14-year historical period
- Verification of model results by assessing, where available, quantitative and qualitative country data and reports related to the socioeconomic impacts of past events
- A stochastic event set in which CCRIF uses statistical techniques to generate a much longer time-series (than the 14-year TRMM data) of rainfall loss events which have the same general characteristics as the known loss events for the 14 years of TRMM data. This 'stochastic' set of events allows for much more robust analysis of long-term loss rates and inter-annual variability, thus providing a more reliable basis for pricing of parametric insurance coverage. This feature benefits the insured country in that it reduces the uncertainty load in pricing.

Establishing a Country's Excess Rainfall Policy

For each country, the following steps are taken to calculate and determine index losses:

Application of historical rainfall data to the exposure database using the vulnerability function generates a historical risk profile (event-specific and annual aggregate)

The risk profile provides the necessary information for CCRIF/Swiss Re to price coverage

Coverage characteristics, within limits, are selected by each country separately (in the same way as existing CCRIF EQ and TC coverage selections are made)

Determination of Premium Cost

The premium for a country's excess rainfall policy is determined by the amount of coverage a country decides to take, the attachment and exhaustion points of that coverage, and the rainfall risk profile of the country. More specifically, a member country's premium cost is based on the frequency with which the rainfall event exceeds the attachment point (as identified by the country-specific rainfall profile) as well as the range between the attachment and exhaustion points and amount of risk being transferred (as encapsulated in the coverage limit).

Note that the XSR product is parametric, so that the premium to payout ratio for a given event is fixed by the probability of the rainfall event occurring with a certain intensity rather than the

Calculation of Payouts

A payout to a country depends on the peak 5-day rainfall for the event, the distribution of high rainfall relative to exposure, and the proportion of the country/exposure impacted. Once the index loss gets above the attachment point (either for a single event for event coverage or in the cumulative annual aggregate for the aggregate coverage) then the payout increases as the index loss increases, until the maximum payout (coverage limit) has been reached.

Differences between the Excess Rainfall Product and CCRIF's Hurricane Product

The excess rainfall product is triggered independently of the current hurricane product, and if both policies trigger then both payouts are due. The current hurricane 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. Notice that rainfall is not included in the tropical cyclone model.

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

List of Acronyms

CCRIF	Caribbean Catastrophe Risk Insurance Facility
CIMH	Caribbean Institute of Meteorology and Hydrology
EQ	Earthquake
GDP	Gross Domestic Product
JAXA	Japan Aerospace Exploration Agency
KAC	Kinetic Analysis Corporation
MPRES	Multi-Peril Risk Estimation System
NASA	US National Aeronautics and Space Agency
TC	Tropical Cyclone
TRMM	Tropical Rainfall Measurement Mission
XSR	Excess Rainfall

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