CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

On behalf of
Caribbean XSR SP

Covered Area Rainfall Event (15-16 November 2018)

Excess Rainfall

Event Briefing

Trinidad and Tobago - Trinidad

22 November 2018

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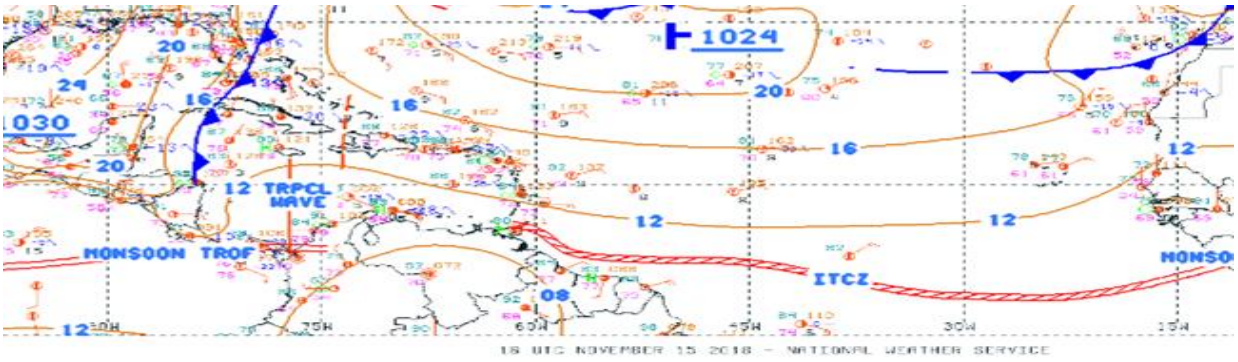
1 INTRODUCTION

An active Inter-Tropical Convergence Zone (ITCZ) produced prolonged periods of rain/showers and thunderstorm activity over Trinidad and Tobago between 14 and 16 November 2018, generating adverse weather mainly over the East and South of Trinidad.

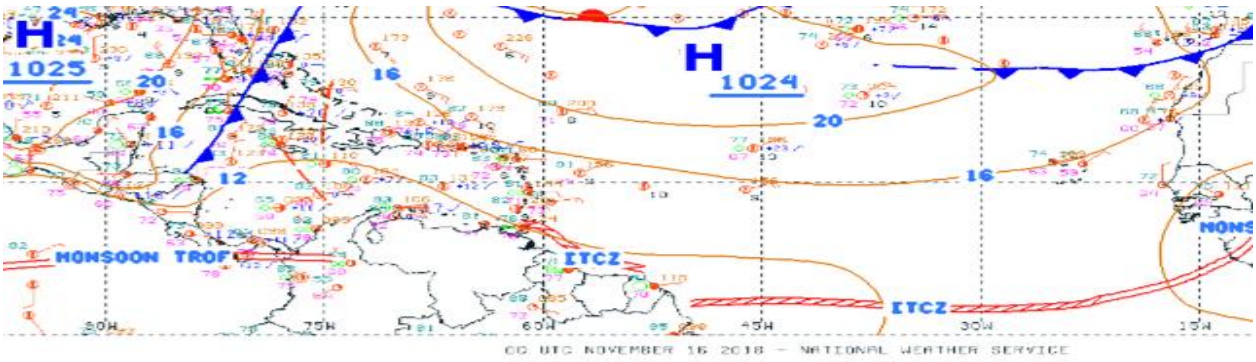
This event briefing describes the impact on the island of Trinidad which was affected by heavy precipitation during this period. The Rainfall Index Loss was calculated for this Covered Area Rainfall Event (CARE), which started on 15 November and ended on 16 November 2018. The Rainfall Index Loss was below the attachment point of Trinidad's Excess Rainfall policy and therefore no payout is due.

2 EVENT DESCRIPTION

On 15 November 2018, the southern Caribbean Sea and the north sector of South America were embedded in a broad area of low pressure. On 15 November at 1800UTC, the Inter Tropical Convergence Zone (ITCZ) approached the tropical Atlantic reaching with its western side over Trinidad and Tobago (Figure 1). At this time the ITCZ was between 8N50W and 11N62W and its location kept almost constant during the subsequent 6 hours (Figure 1). The strong convergence at the surface, associated with the high availability of precipitable water in the atmosphere, favoured the deep convection. This led to the development of scattered moderate to isolated strong rain showers near Trinidad from 08N to 12N between 57W and 63W from 15 November at 0600UTC to 16 November at 0600UTC (Figure 2).



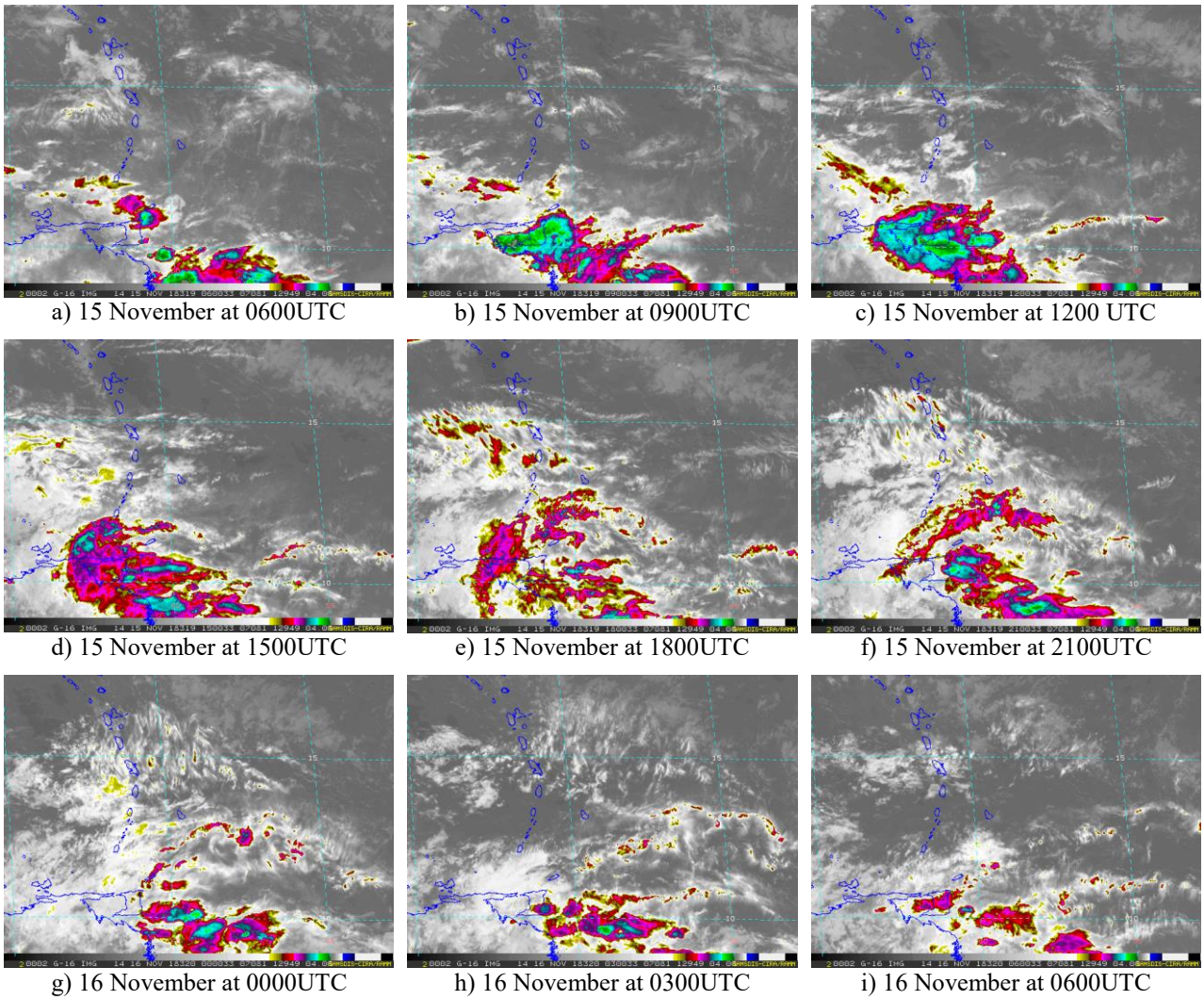
a) 15 November at 1800UTC



b) 16 November at 0000UTC

Figure 1 Surface analysis maps at different times. Source: US National Hurricane Center (NHC).

The satellite images collected by GEOS-16 (Figure 2) provide a higher detail for the precipitation that occurred over the region during the event. They reported a core of intense precipitation that affected Trinidad on 15 November from 0600UTC to 1500UTC. Afterwards, diffused moderate to locally intense rainfall was present over the area and partially affected Trinidad



a) 15 November at 0600UTC b) 15 November at 0900UTC c) 15 November at 1200 UTC

d) 15 November at 1500UTC e) 15 November at 1800UTC f) 15 November at 2100UTC

g) 16 November at 0000UTC h) 16 November at 0300UTC i) 16 November at 0600UTC

Figure 2 Thermal infrared IR4 images from satellite GEOS-16 at 2km resolution. Colors indicate the temperature of the cloud top: cold colors stay for high topped clouds associated with intense convection and thunderstorm, while warm colors stay for low topped clouds associated to shallower convection and less intense precipitation. Source: NOAA satellite and information, *http://rammb.cira.colostate.edu/*

The satellite precipitation estimates of the IMERG (Integrated Multi-satellitE Retrievals for GPM) dataset indicated that during the event (from 14 to 16 November), the highest values of the accumulated precipitation were over the south and east portions of Trinidad and over the waters to the southeast (Figure 3). According to IMERG, these areas were affected by values of accumulated precipitation ranging from 100 mm up to 180 mm.

No data collected by the surface rain gauges have been published yet by NOAA (NNDC Climate data online, source: https://data.noaa.gov/dataset/dataset/global-surface-summary-of-the-day-gsod) for the two stations located in Trinidad and Tobago (i.e. Piarco, located in the centre-north of Trinidad, and Arthur Napoleon Raymond Robin, sited on the southwest edge of Tobago).

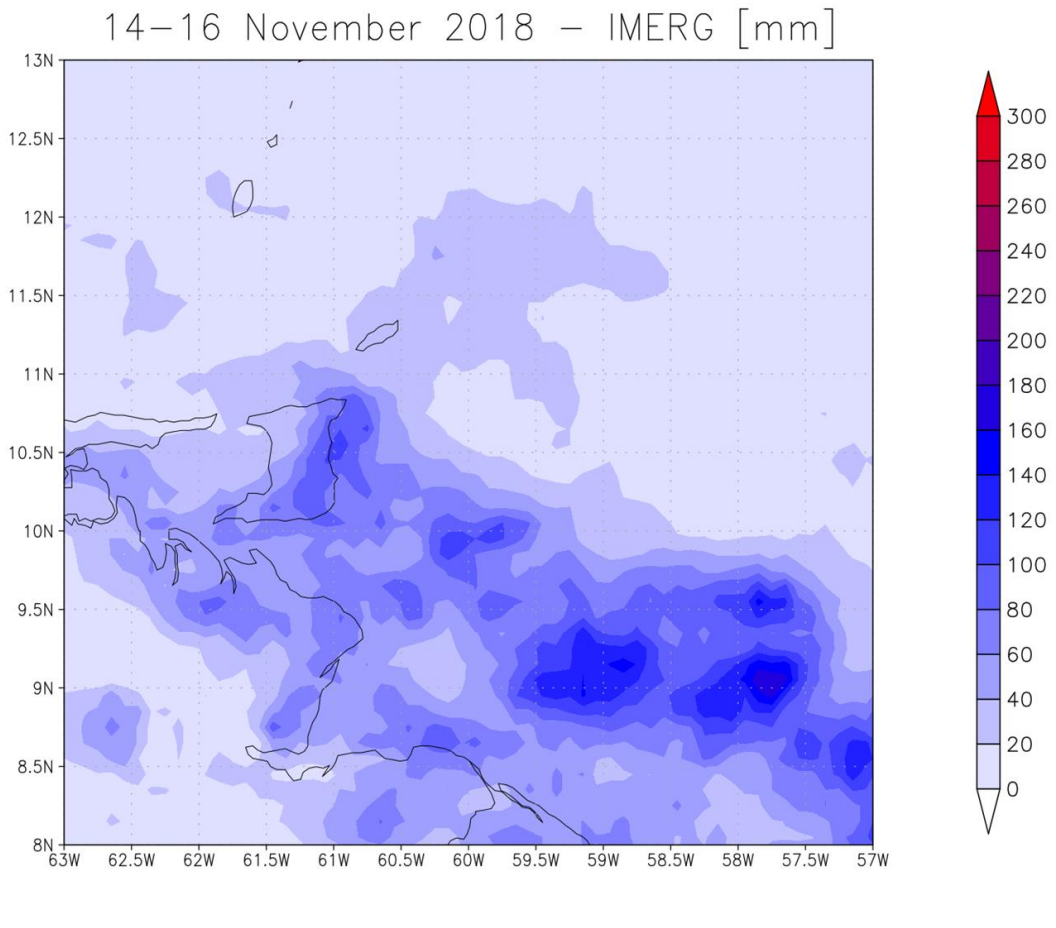


Figure 3 IMERG accumulated precipitation (rainfall) at 10 km resolution over Trinidad from 14 to 16 November 2018. Source: XSR Web

3 IMPACTS

According to the Government of Trinidad and Tobago the regional corporations most severely impacted were Penal/Debe, Point Fortin Borough, Sangre Grande, with minor damage to the regional corporations of San Juan/Laventille, Siparia, Mayaro/ Rio Claro, Tunapuna/ Piarco, Couva/Tabaquite/Talparo, San Fernando City.

The majority of the reports pertained to flooding and landslides. Traffic was interrupted by the flooding of roads and highways and falling trees were reported. Flood waters have affected nearly 600 households across East and South Trinidad caused by the heavy rains.

The Trinidad and Tobago Meteorological Service (TTMS) issued an Orange Riverine Flood Alert and Yellow Hazardous Seas Alert. The Office of Disaster Preparedness and Management (ODPM) activated its national response mechanism.

Figure 4 shows some flood damage caused by this Inter-Tropical Convergence Zone in Trinidad.

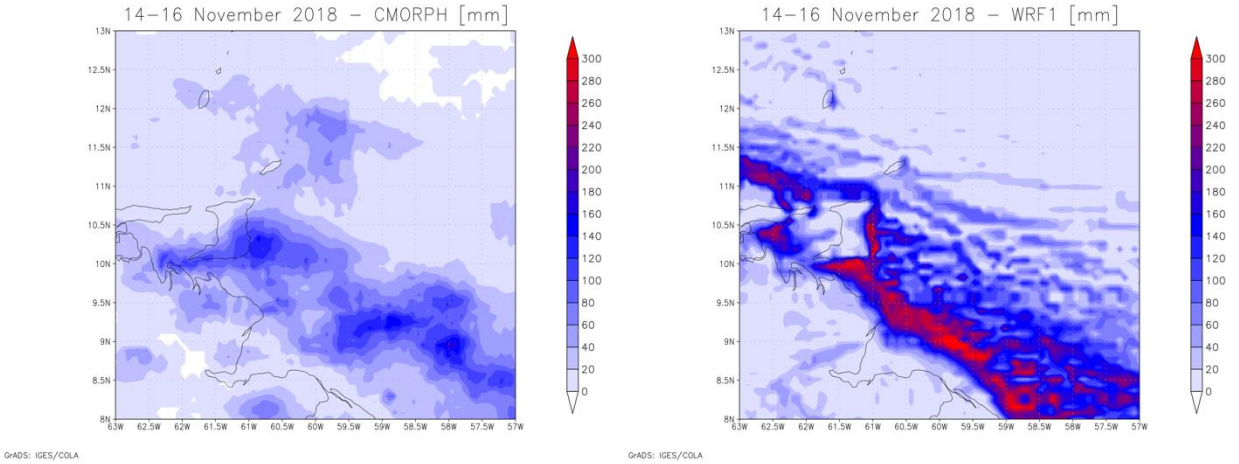
Figure 4 Damage caused by heavy rainfall in Trinidad – November 2018.
Sources: *Trinidad Express Newspapers*, and *Loop*

4 RAINFALL MODEL OUTPUTS

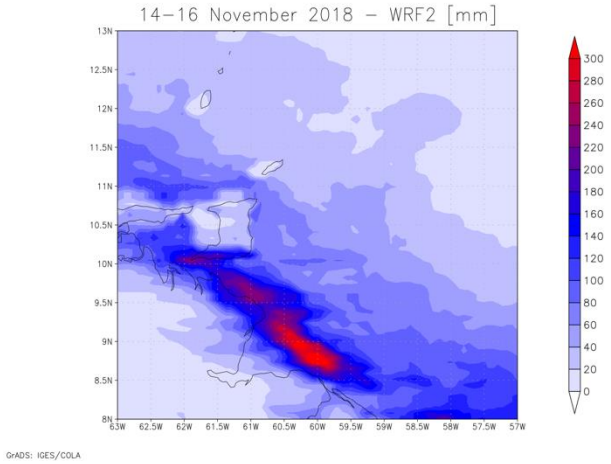
All three models used by the XSR 2.1 model, CMORPH[1], WRF1 and WRF2[2], simulated the heavy precipitation associated with the passage of the ITCZ line in the region during the period 15-16 November 2018. All the models simulated the highest precipitation occurring over the south and/or east portion of Trinidad and the waters to the southeast (Figure 5), with a peak of accumulated values in these areas of 180 mm for CMORPH, 370 mm for WRF1 and 320 mm for WRF2.

[1] CMORPH Model: the satellite-based rainfall precipitation estimates provided by the NOAA Climate Prediction Center (CPC) using the so-called Morphing Technique *http://www.cpc.ncep.noaa.gov/products/janowiak/cmorph_description.html*. Further details in the Definitions section of this report.

[2] WRF1 and WRF2 Models: the Weather Research and Forecasting Model weather model-based Configuration #1 and #2 data *https://www.mmm.ucar.edu/weather-research-and-forecasting-model*. These data are initialised by the NCEP FNL dataset. (NCEP FNL Operational Model Global Tropospheric Analyses [*http://rda.ucar.edu/datasets/ds083.2/*]). Further details in the Definitions section of this report.



a) CMORPH b) WRF1



c) WRF2

Figure 5 Accumulated precipitation at 8km resolution during 14-16 November 2018 simulated by the models CMORPH, WRF1 and WRF2. Source: XSR Web

In particular, over Trinidad (Figure 6):

- CMORPH simulated most of the precipitation falling on 15 November. Daily accumulated values greater than 60 mm were produced over the southeast portion of the island with peaks of 100-120 mm.
- WRF1 showed most of the rainfall affecting Trinidad between 14 and 15 November. The precipitation was mainly over the east side of the island with daily accumulated values greater than 60 mm and peaks of 120-160 mm along the east coast.
- WRF2 reported precipitation with a similar temporal and spatial pattern of CMORPH, but the largest daily accumulated value was only on the south of the island with peaks of 160-180mm.

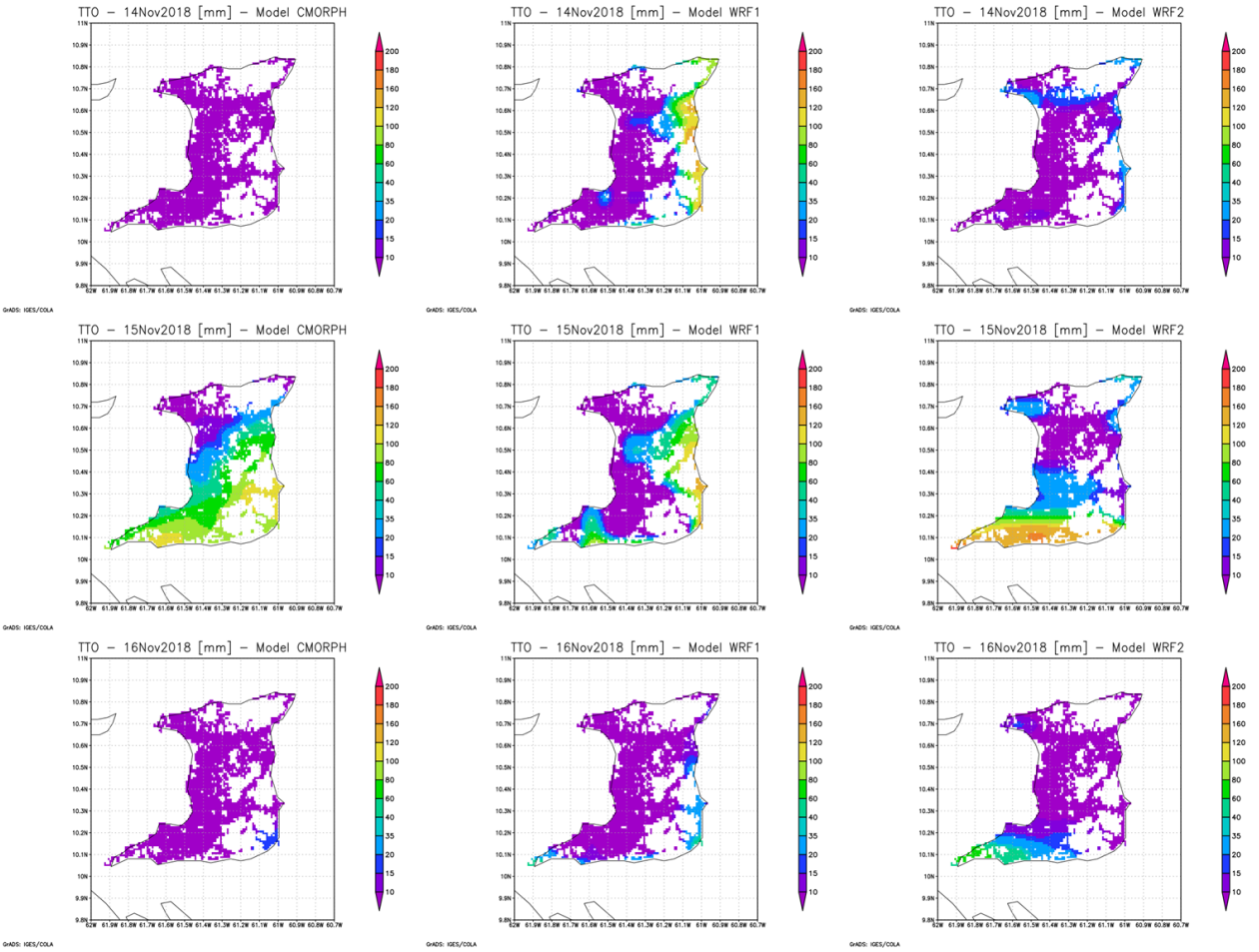


Figure 6 Accumulated precipitation (rainfall) at 1km resolution over Trinidad exposure on 14, 15, and 16 November 2018 (from top to bottom) by CMORPH (left), WRF1 (centre) and WRF2 (right). Source: XSR Web.

The highest Rainfall Index Loss (RIL) was produced by WRF1 (RIL_{WRF1} = US$16,518,640.64), due to the high accumulated precipitation during the event. WRF2 produced an RIL (RIL_{WRF2}= US$12,769,239.20), which was only slightly lower than RIL_{WRF1}. Indeed, despite the fact that WRF2 simulated lower peaks of precipitation than WRF1, it reported high precipitation values also on the southern sector of Trinidad, where the exposure is denser. Finally, CMORPH produced the lowest RIL value (RIL_{CMORPH} = US$6,788,318.55), due to the low amount of precipitation simulated over Trinidad.

All three models produced a Rainfall Index Loss larger than the Country Loss Threshold (US$6,000,000). Therefore, the final RIL for this event (RIL_{FINAL} = US$12,025,399.46) was equal to the average of the CMORPH, WRF1 and WRF2 RILs. The final RIL was lower than the policy attachment point for Trinidad's Excess Rainfall policy, and therefore this event was classified as a loss event and does not trigger a payout.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) was below the attachment point of Trinidad's Excess Rainfall policy and therefore no payout is due.

CCRIF expresses empathy with the Government and people of Trinidad and Tobago for the impacts on communities and infrastructure caused by this event.

For further information, please contact ERN-RED, the CCRIF SPC Risk Management Specialist.

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DEFINITIONS

Active Exposure Cell Percentage Threshold	The percentage of the total number of XSR Exposure Grid Cells as defined in the Schedule, with in the covered Area of the Insured, which when exceeded triggers a Covered Area Rainfall Event.
Active Exposure Grid Cells	The XSR Exposure Grid Cells for which in the same single day the Average Aggregate Rainfall value computed using the CMORPH-based Rainfall Estimate equals or exceeds the Rainfall Event Threshold.
Average Aggregate Rainfall	The Average Aggregate Rainfall amount (where the number of days in the Rainfall Aggregation Period is defined in the Schedule) as measured in millimeters per day (mm/day) in any of the XSR Exposure Grid Cells in the Covered Area of the Insured. For a given number of days n, the n-day aggregation period is the average of rainfall on the day itself and on the previous n-1 days.
Calculation Agent	Entity charged with undertaking the primary calculation of the Rainfall Index Loss as described in the Calculation Agency Agreement.
CMORPH-based Maximum Average Aggregate Rainfall	The maximum value during the Covered Area Rainfall Event of the Average Aggregate Rainfall computed using the CMORPH-based Daily Rainfall Estimates in any given XSR Exposure Grid Cell over the Covered Area of the Insured.
CMORPH-based Covered Area Rainfall Parameters	The CMORPH Model information provided on a continuous basis by the XSR Model Data Reporting Agency used by the Calculation Agent to obtain the CMORPH-based Daily Rainfall Estimates using the XSR Rainfall Model. Parameters are drawn from XSR Exposure Grid Cells within the Covered Area of the Insured as identified in the Cell Identification and Rainfall Exposure Value Table in the Schedule, by their respective latitude and longitude. Measurement units and precision of data ingested by the XSR Rainfall Model are identical to those provided by the XSR Model Data Reporting Agency and are further elaborated in the Attachment entitled 'Calculation of Rainfall Index Loss and Policy Payment'.
CMORPH Model	The satellite-based rainfall estimation model provided by NOAA CPC as described in the Rainfall Estimation Models section of the Policy.

Covered Area	The territory of the Insured as represented in the XSR Rainfall Model.
Covered Area Rainfall Event	Any period of days, with an interruption less than or equals to the Event Tolerance Period, during which the number of Active Exposure Grid Cells is greater than or equal to the product of (a) Active Exposure Cell Percentage Threshold multiplied by (b) the total number of XSR Exposure Grid Cells within the Covered Area.
Country Disaster Alert	An official disaster alert issued by Relief Web (http://reliefweb.int/) for the country in question for one of the following types of events: tropical cyclone, flood, flash flood and severe local storm. Any disaster alert issued later than seven (7) days after the completion of the Covered Area Rainfall Event will not be considered.
Maximum Average Aggregate Rainfall	The highest value during a Covered Area Rainfall Event of the Average Aggregate Rainfall amount in any of the XSR Exposure Grid Cells in the Covered Area of the Insured computed.
Rainfall Event Threshold	Average Aggregate Rainfall level as defined in the Schedule which should be exceeded to trigger an Active Exposure Cell.
Rainfall Aggregation Period	The number of days over which the Average Aggregate Rainfall is computed for all XSR Exposure Grid Cells during a Covered Area Rainfall Event.
Rainfall Index Loss	For any Covered Area Rainfall Event affecting the Insured, the US Dollar loss calculated by the Calculation Agent using the XSR Rainfall Model, as described in the Attachment entitled 'Calculation of Rainfall Index Loss and Policy Payment'. The Rainfall Index Loss can only be calculated once the Covered Area Rainfall Event is completed.
WRF1 Model	The weather research and forecasting rainfall model by NOAA with Configuration #1 data initialized by the National Center for Environmental Prediction as described in the Rainfall Estimation Models and in the Input Data to the Rainfall Estimation Models sections of the Policy.
WRF2 Model	The weather research and forecasting rainfall model by NOAA with Configuration #2 data initialized by the National Center for Environmental Prediction as described in the Rainfall Estimation

	Models and in the Input Data to the Rainfall Estimation Models sections of this Attachment.
XSR Rainfall Model	The computer model used to calculate the Rainfall Index Loss, as described in the Attachment entitled 'Calculation of Rainfall Index Loss and Policy Payment'.
XSR Exposure Grid Cells	The 30 arc-second by 30 arc-second grid of cells each of which is attributed with an XSR Grid Cell Exposure Value greater than zero, as provided in the Schedule.
XSR Grid Cell Exposure Value	The value, as shown in the Cell Identification and Rainfall Exposure Value Table in the Schedule, used to calculate the CMORPH-based Exposure Grid Cell Loss, the WRF1-based Exposure Grid Cell Loss, and the WRF2-based Exposure Grid Cell Loss.