CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

On behalf of
Caribbean XSR SP

Covered Area Rainfall Event (30-31 December 2017)

Excess Rainfall

Event Briefing

Trinidad

6 January 2018

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1 INTRODUCTION

A low-level system with prolonged and heavy rainfall affected CCRIF member country, Trinidad and Tobago. Trinidad and Tobago has two Excess Rainfall policies – one for the island of Trinidad and the other for the island of Tobago.

This event briefing describes the impact on the island of Trinidad which was affected by heavy precipitation between 29 and 31 December. The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) started on 30 December and ended on 31 December 2017. The Rainfall Index Loss calculated for this CARE was below the attachment point of Trinidad's Excess Rainfall policy and therefore no payout is due. For Tobago the XSR model did not trigger a CARE and therefore did not register a Rainfall Index Loss.

2 EVENT DESCRIPTION

On December 30 and 31, 2017, the Caribbean basin was dominated by a middle to upper level ridge with axis from Trinidad to Nicaragua. At lower level, moderate to fresh trades dominated the southern Caribbean waters. In particular in the south eastern sector of the basin, a region of middle level moisture insisted over the Windward Islands and Trinidad and Tobago (Figure 1). This configuration supported scattered showers over the Windward Islands and scattered moderate showers over Trinidad, especially on December 30.

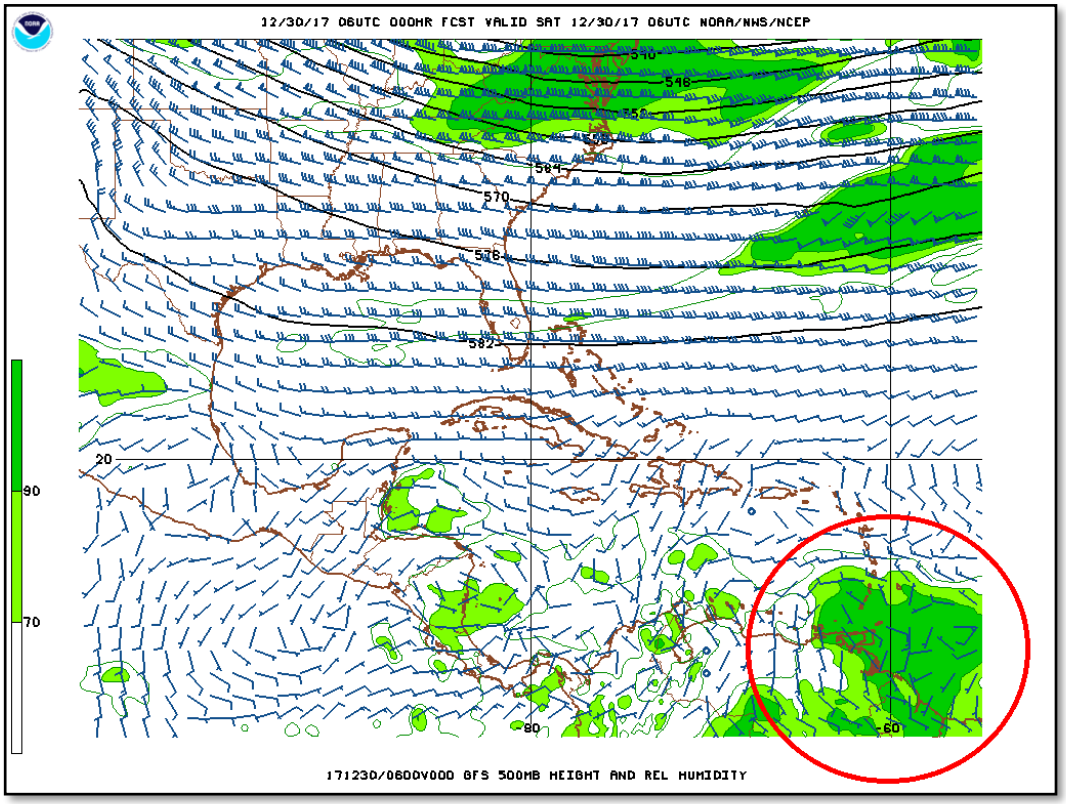
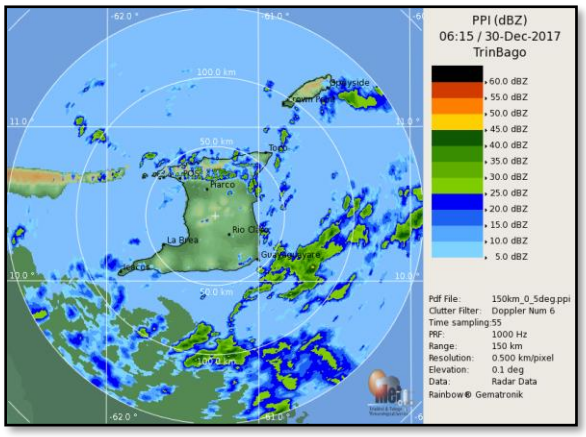
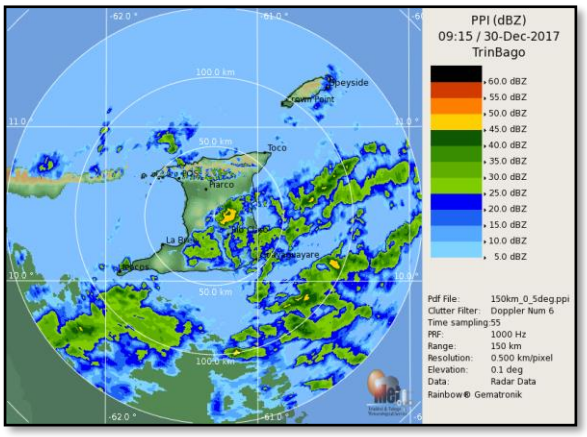


Figure 1 -500mb analysis showing geopotential height, wind speed and relative humidity valid at the 0600UTC on 30 December. (Source: NOAA).

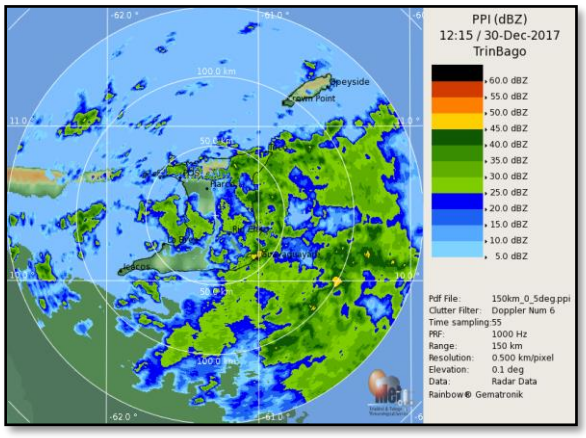
The radar located over Trinidad indicated that scattered moderate and locally intense precipitation started to affect Trinidad on 30 of December at 0745 UTC (Figure 2). At 1215 UTC, the precipitation assumed a more diffused pattern over the island, while it kept the same intensity. The rainfall event over Trinidad closed at about 2030 UTC.



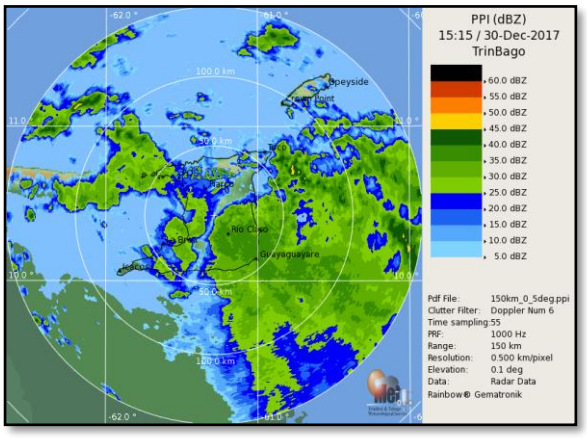
a) 30 December 0615 UTC



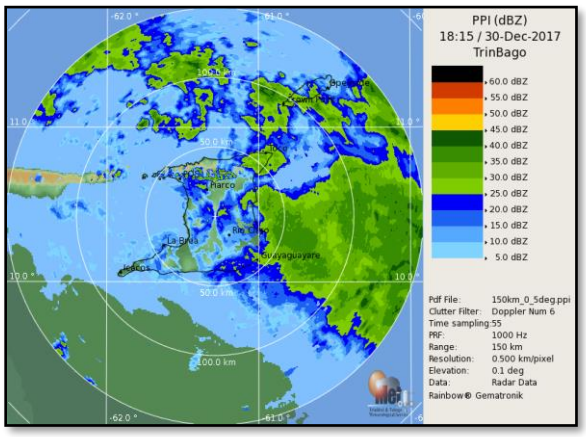
b) 30 December 0915 UTC



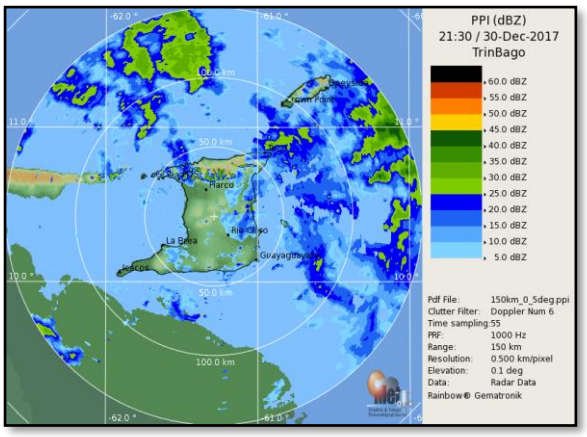
c) 30 December 1215 UTC



d) 30 December 1515 UTC



e) 30 December 1815 UTC



f) 30 December 2130 UTC

Figure 2-Radar imagery (ppi in dBZ) with a range of 150 km. Source: http://www.metoffice.gov.tt

Ground measurement at Piarco (north-central sector) and at Arthur Napoleon Raymond Robin (north-eastern sector) reported 44.2 mm and 7.9 mm of precipitation respectively on 30 of December (source: https://www1.ncdc.noaa.gov).

3 IMPACTS

According to the Office of Disaster Preparedness and Management the areas most severely impacted were Mayaro/Rio Claro, San Juan/Laventille and Penal/Debe Regional Corporations. The Trinidad and Tobago Meteorological Service activated the riverine flood alert and national response mechanism.

Most of the regional corporations in Trinidad territory suffered impacts such as:

- flooding of streets and roads and buildings and houses,
- fallen trees and light poles,
- overflowing of rivers,
- landslides (a massive landslide occurred on the North Coast Road),
- disruption of water supply in many areas.

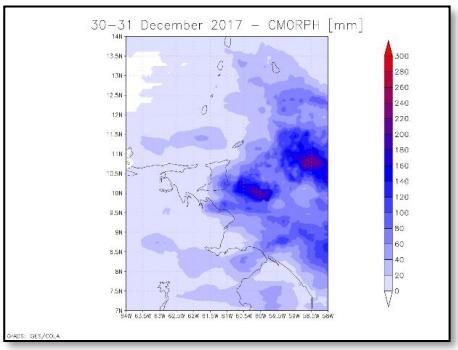
Additionally, the rains also resulted in increased traffic. Figure 3 shows the landslide and flood damages caused by heavy rainfall in Trinidad.

Figure 3-Damage caused by heavy rainfall in Trinidad– December 2017.
Sources: *Newsday* and *Trinidad Express*

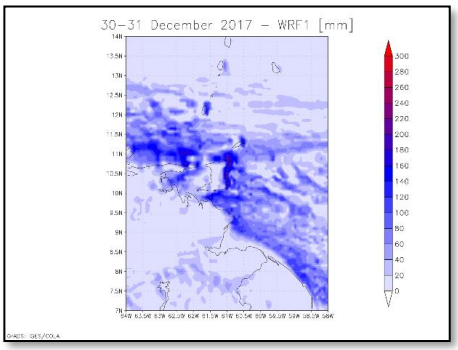
4 RAINFALL MODEL OUTPUTS

The general spatial patterns of the accumulated precipitation reported by CMORPH [1], WRF1 and WRF2 [2] (Figure 4) are quite different:

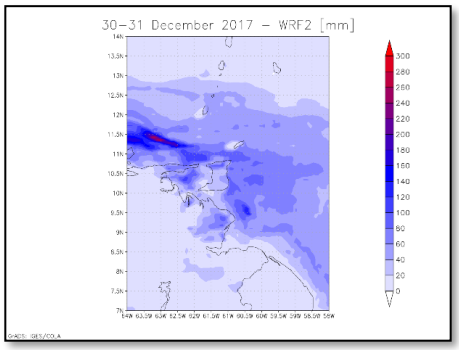
- CMORPH shows the largest amount of accumulated precipitation (261mm) in two cores to the east and north-east of Trinidad, while the island itself was affected in its centre-southern sector;
- WRF1 shows a more scattered precipitation pattern with the largest amount of rainfall (214mm) over the eastern coast of Trinidad i, while the internal part of the island was only marginally affected.
- WRF2 shows an intense precipitation core (with maximum of 270 mm) to the north-west of Trinidad and a moderate nucleus to the east of it, while the island itself was more affected in the northern sector.



a) CMORPH



b) WRF1



c) WRF2

Figure 4-Accumulated precipitation on days 30-31 of December 2017, in the simulation performed by CMORPH, WRF1 and WRF2. Source: XSR Web

[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 is 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.

Figure 5 illustrates in detail the accumulated precipitation simulated by CMORPH, WRF1 and WRF2 over Trinidad on 30 December, the day in which the highest t amount of precipitation occurred. Among the three models, WRF1 presents the highest amount of precipitation (120-160 mm over the east coast) and this results in the higher RIL computed using WRF1 data (RIL_{WRF1}=7,220,324.9 $). CMORPH shows a lower maximum (100-120mm) in the south-east side of the island, where the exposure map reports only few points at high value. This resulted in the intermediate RIL computed using CMORPH (RIL_{CMORPH}=3,296,277.6 $). Finally, WRF2 reports the lowest amount of precipitation, resulting in the lower value of RIL computed on its base (RIL_{WRF2}=2,385,884.3 $). Since all the models overcome the Loss Threshold, the final RIL has been computed as the average of the three model RILs (RIL_{FINAL}=4,300,829.0 $).

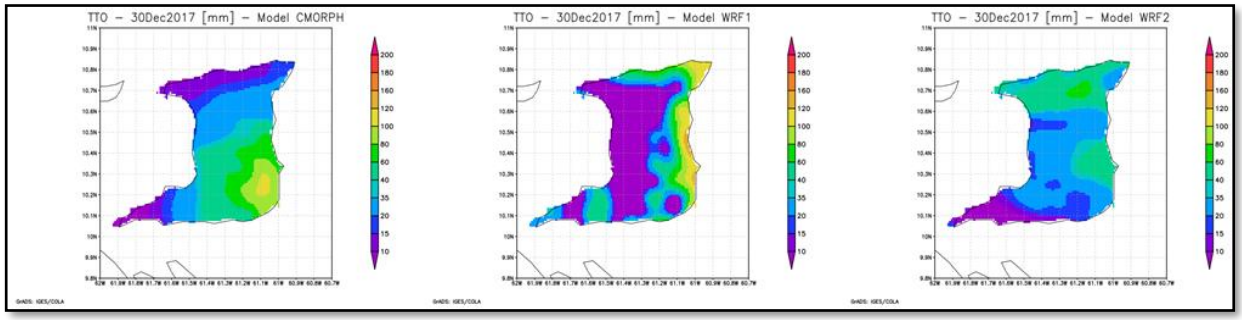


Figure 5-Accumulated precipitation on 30 of December over Trinidad in the simulation performed by CMORPH, WRF1 and WRF2. Source: XSR Web.

5 TRIGGER POTENTIAL

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

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.