CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

On behalf of
Caribbean XSR SP

Covered Area Rainfall Event (18-20 October 2018)

Excess Rainfall

Event Briefing

Trinidad and Tobago - Trinidad

26 October 2018

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1 INTRODUCTION

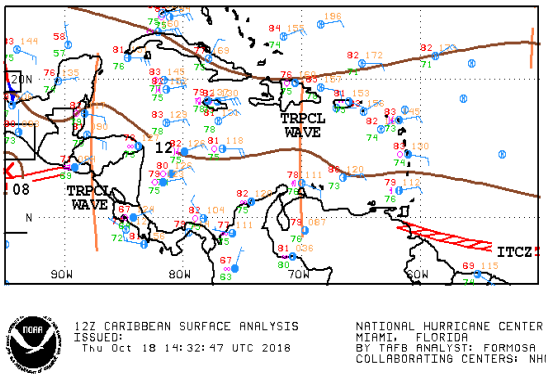
An active Inter-Tropical Convergence Zone (ITCZ) produced prolonged periods of rain/showers and thunderstorm activity over Trinidad and Tobago. According to Government officials, due to adverse weather, Trinidad received a full month's worth of rain during two days (October 18 and 19) alone.

This event briefing describes the impact on the island of Trinidad which was affected by heavy precipitation between 17 and 20 October. The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) that started on 18 October and ended on 20 October 2018, indicated government losses above the attachment point of Trinidad's Excess Rainfall policy. Final calculations show that a payout of US$2,534,550.65 is due.

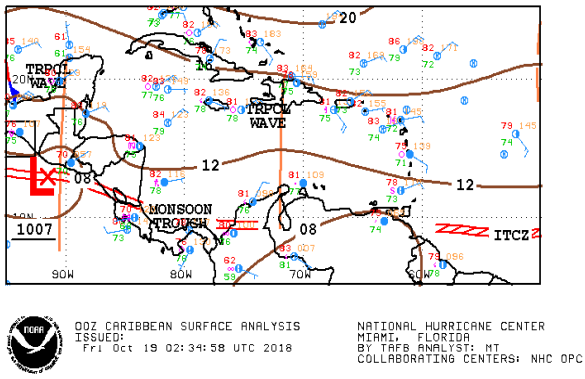
The Government of Trinidad and Tobago purchased two separate Excess Rainfall policies – one for Trinidad and one for Tobago. Tobago's policy was not triggered by this event and therefore no payout is due on Tobago's policy.

2 EVENT DESCRIPTION

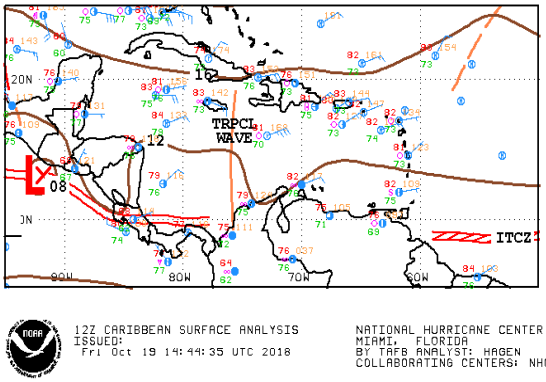
On 18 October 2018, the Inter Tropical Convergence Zone (ITCZ) approached the tropical Atlantic to the southeast of Trinidad and Tobago (Figure 1). At 1200UTC the ITCZ was between 8N50W and 10N60W and its location kept almost constant during the subsequent 24 hours (Figure 1). The strong convergence at the surface, associated with the high moisture availability in the middle atmosphere and local minimum pressure at the same level (Figure 2), favoured the deep convection. This led to the development of scattered moderate to isolated strong rain showers near Trinidad from 08N to 13N between 57W and 63W from 17 October at 1200UTC to 21 October at 0600UTC.



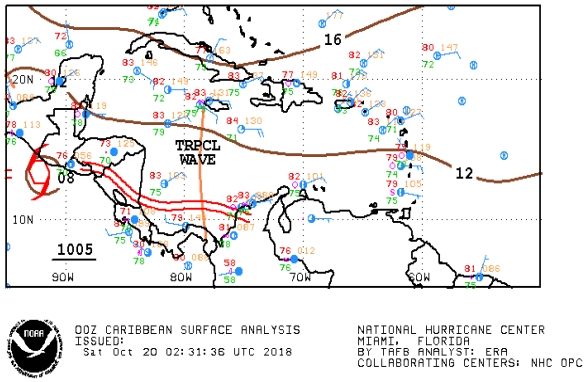
a) 18 October at 1200UTC



b) 19 October at 0000UTC



c) 19 October at 1200UTC



d) 20 October at 0000UTC

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

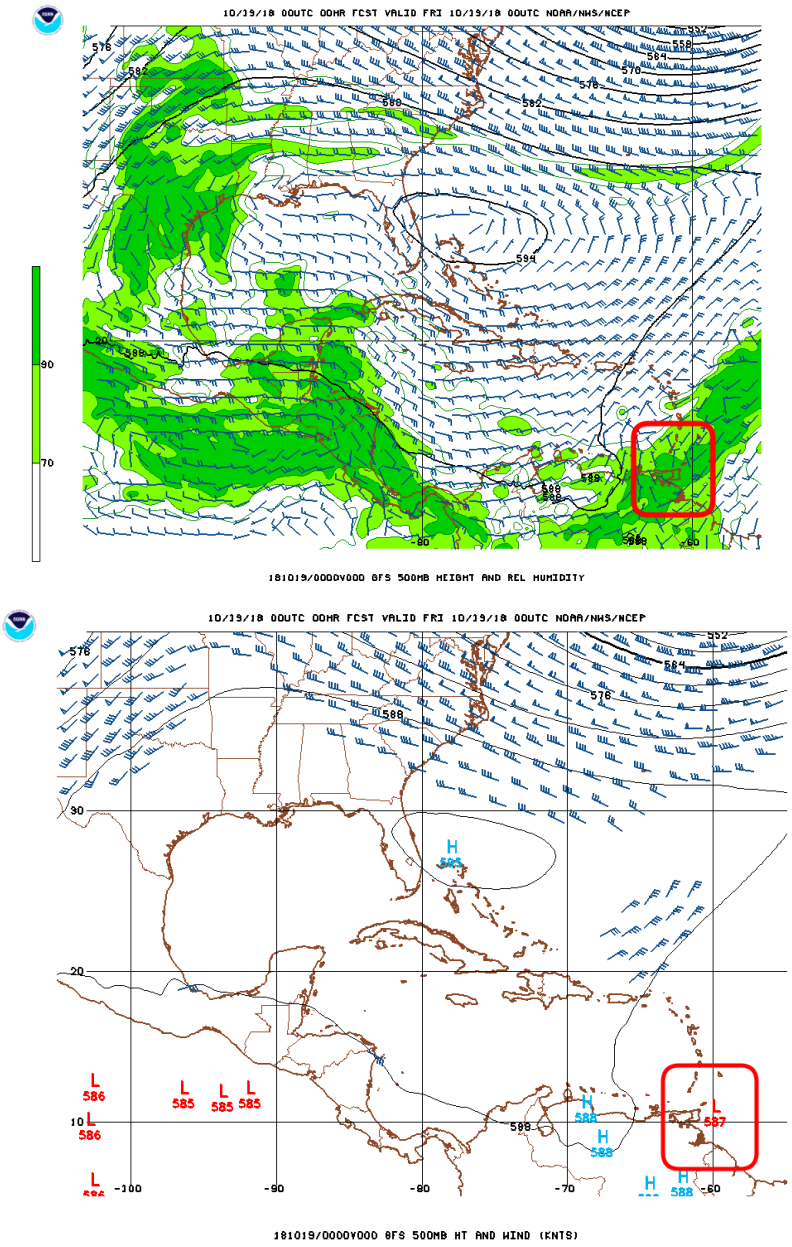
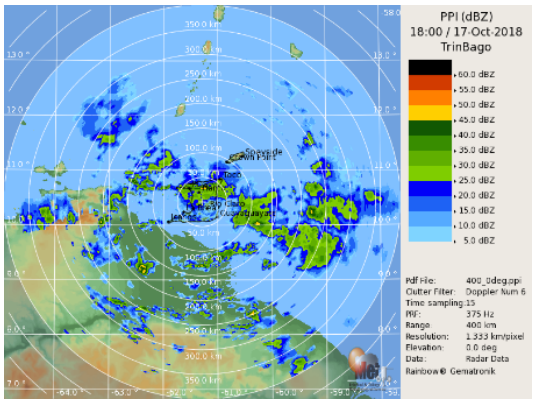
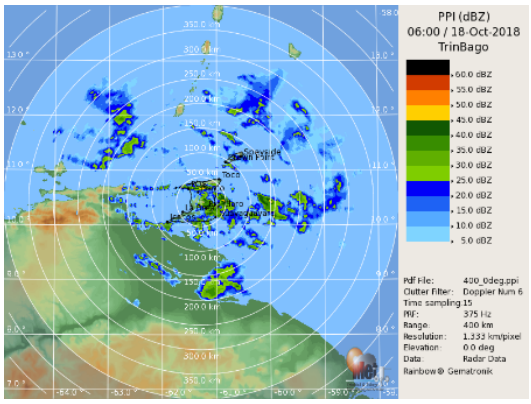


Figure 2 Upper level analyses on 19 October at 0000UTC. Top: geopotential height and relative humidity at 500 mb, bottom: geopotential height and wind speed at 500 mb (minimum pressures are highlighted in red). Trinidad and the surrounding area are shown within the red square. Source: US National Hurricane Center (NHC).

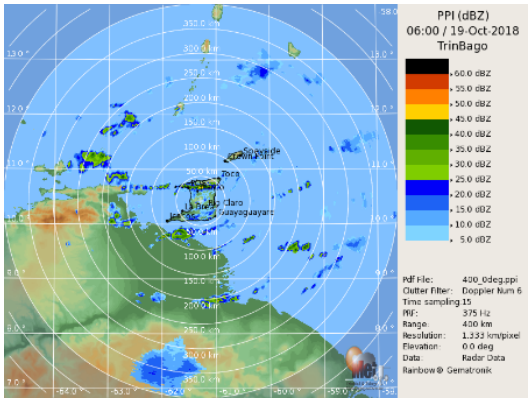
The reflectivity maps collected by the radar sited over Trinidad provide a higher detail for the precipitation that occurred over the region during the event. They reported moderate rainfall on 17 October from 1700UTC to 2130UTC, diffused moderate to locally intense rainfall on 18 October from 0600UTC to 2100UTC and from 19 October at 1000UTC to 20 October at 0200UTC. Afterwards, intense precipitation affected mainly the waters to the northeast of Trinidad and part of Tobago. Over Trinidad on 20 October, the radar showed only some scattered moderate rainfall.



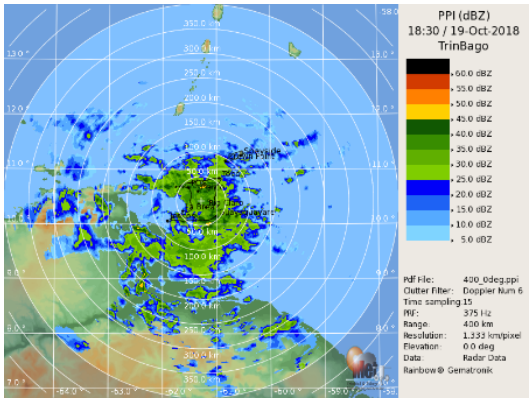
a) 17 October at 1800UTC



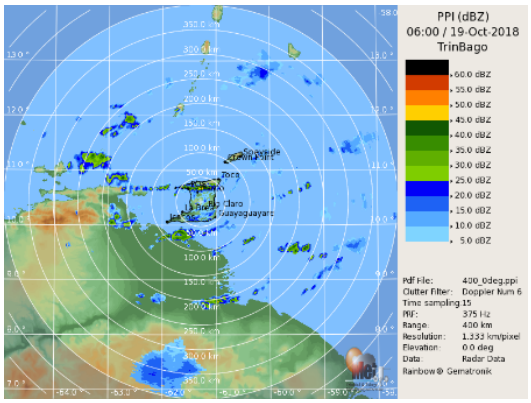
b) 18 October at 0600UTC



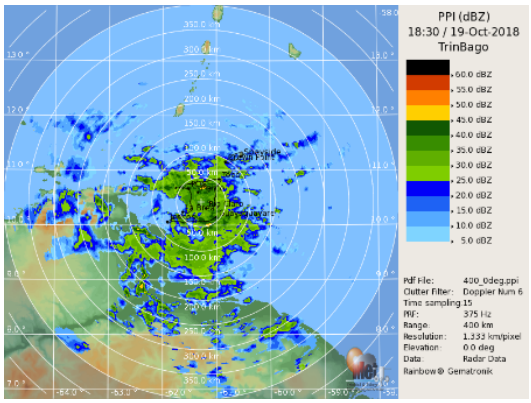
c) 18 October at 1815UTC



d) 19 October at 0600UTC



e) 19 October at 1830UTC



f) 20 October at 0600UTC

Figure 3 Reflectivity maps (PPI) collected by the radar sited over Trinidad at different times.
Source: http://www.metoffice.gov.tt/.

The satellite precipitation estimates of the IMERG (Integrated Multi-satellitE Retrievals for GPM) dataset indicated that during the event (from 17 to 21 October), the highest values of the accumulated precipitation were over the northeastern portion of Trinidad and over the waters to the east. According to IMERG, these areas were affected by values of accumulated precipitation ranging from 160 mm up to 320 mm.

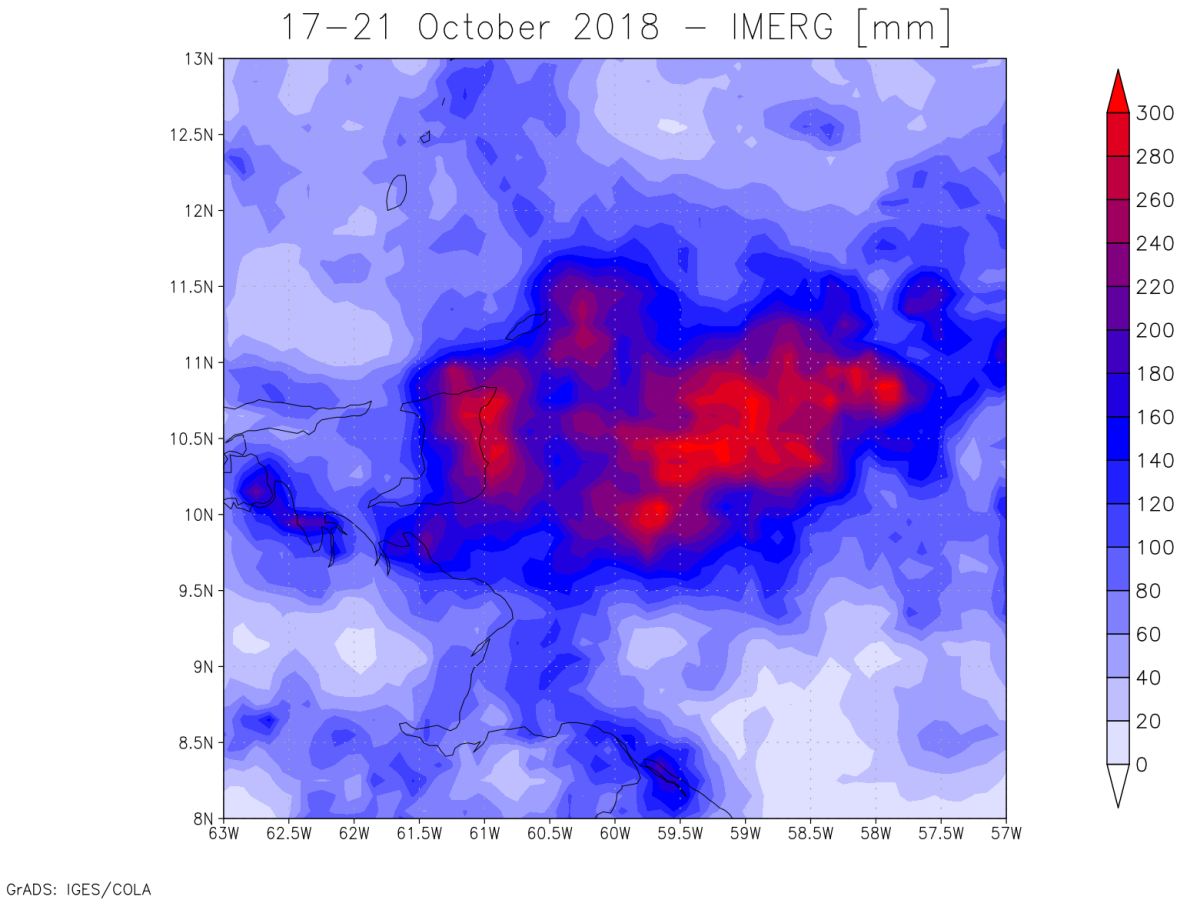


Figure 4 IMERG accumulated precipitation (rainfall) at 10 km resolution over Trinidad on 17 and 21 October 2018. Source: XSR Web.

The surface rain gauges data published by NOAA (NNDC Climate data online, source: *https://data.noaa.gov/dataset/dataset/global-surface-summary-of-the-day-gsod*) reported the daily accumulated values for two stations in Trinidad and Tobago (Table 1). The first one is Piarco, located in the centre-north of Trinidad, while the second is Arthur Napoleon Raymond Robin, sited on the southwest edge of Tobago. The total accumulated rainfall during the event measured at Piarco was almost double the value recorded by the rain gauge in Tobago. Moreover, the highest rainfall recorded in Piarco occurred on 18 and 19 October.

Table 1 Daily accumulated rainfalls measured, in mm, by the surface rain gauges reported by NOAA, (NNDC Climate data online, source: *https://data.noaa.gov/dataset/dataset/global-surface-summary-of-the-day-gsod*)

	17 Oct	**18 Oct**	**19 Oct**	**20 Oct**	**Total**
PIARCO (10.6N 61.3W)	1.8	96.5	49.0	0.0	**147.3**
ARTHUR NAPOLEON RAYMOND ROBIN (11.1N 60.8W)	2.8	0.0	1.3	78.0	**82.1**

3 IMPACTS

According to Prime Minister, Dr. Keith Mitchell, due to the impacts of this adverse weather, a *National Disaster* was declared.

The worst hit regional corporations were Tunapuna, Sangre Grande, Couva-Tabaquite-Talparo, Mayaro Rio Claro, and Chaguanas Borough. Severe flooding occurred in the following areas: Saint Helena, Kelly Village, Santa Monica, Madras, Vega Oropuche, and North Oropuche. Many parts of the country were flooded and there have been widespread reports of landslides and road blocks caused by heavy rains.

At the time of this report, the following impacts had been reported:

- 150,000 people were affected
- 800 people were evacuated
- 4,100 homes were affected
- 13 shelters were opened
- 15 schools were closed

The Trinidad and Tobago Meteorological Service (TTMS) issued a Red Riverine Flood Alert and the Office of Disaster Preparedness and Management (ODPM) activated its national response mechanism.

Figure 5 shows some flood damage caused by this Inter-Tropical Convergence Zone in Trinidad.

Figure 5 Damage caused by heavy rainfall in Trinidad – October 2018.
Sources: *Trinidad Express Newspapers*, *Loop* and *Jamaica Observer*

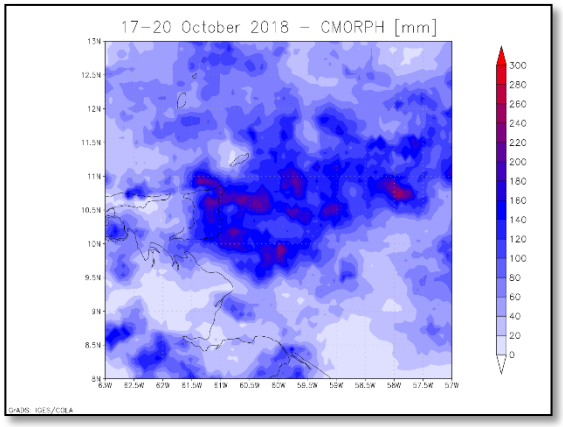
4 RAINFALL MODEL OUTPUTS

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 17-20 October 2018.

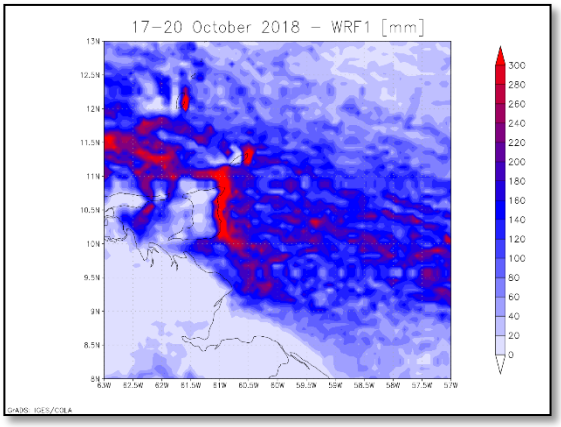
CMORPH simulated the highest precipitation occurring over Trinidad and the waters to the east (Figure 6), while WRF1 simulated the highest precipitation along the eastern coast of both Trinidad and Tobago and over the waters to the northwest and east.WRF2 represented the largest rainfall over the waters to the north and northwest of Trinidad.

[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.

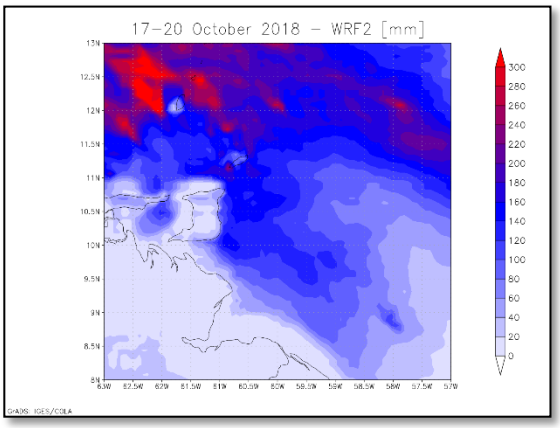
[2] WRF1 and WRF2 Models: the Weather Research and Forecasting Model weather model-based Configuration #1 and #2 data *https://www.mmm.ucar.edu/weather-research-and-forecasting-model*. These data are initialised by the NCEP FNL dataset. (NCEP FNL Operational Model Global Tropospheric Analyses [*http://rda.ucar.edu/datasets/ds083.2/*]).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



a) CMORPH



b) WRF1



c) WRF2

Figure 6 Accumulated precipitation at 8km resolution during 17-20 October 2018 simulated by the models CMORPH, WRF1 and WRF2. Source: XSR Web

In particular, over Trinidad (Figure 7):

- CMORPH simulated most of the precipitation falling between 18 and 19 October. Daily accumulated values greater than 60 mm were produced over the greater part of the island, with peaks of 100-120 mm.
- WRF1 similarly showed most of the rainfall affecting Trinidad between 18 and 19 October. However, the precipitation was mainly sited on 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 simulated low precipitation over Trinidad during this event.

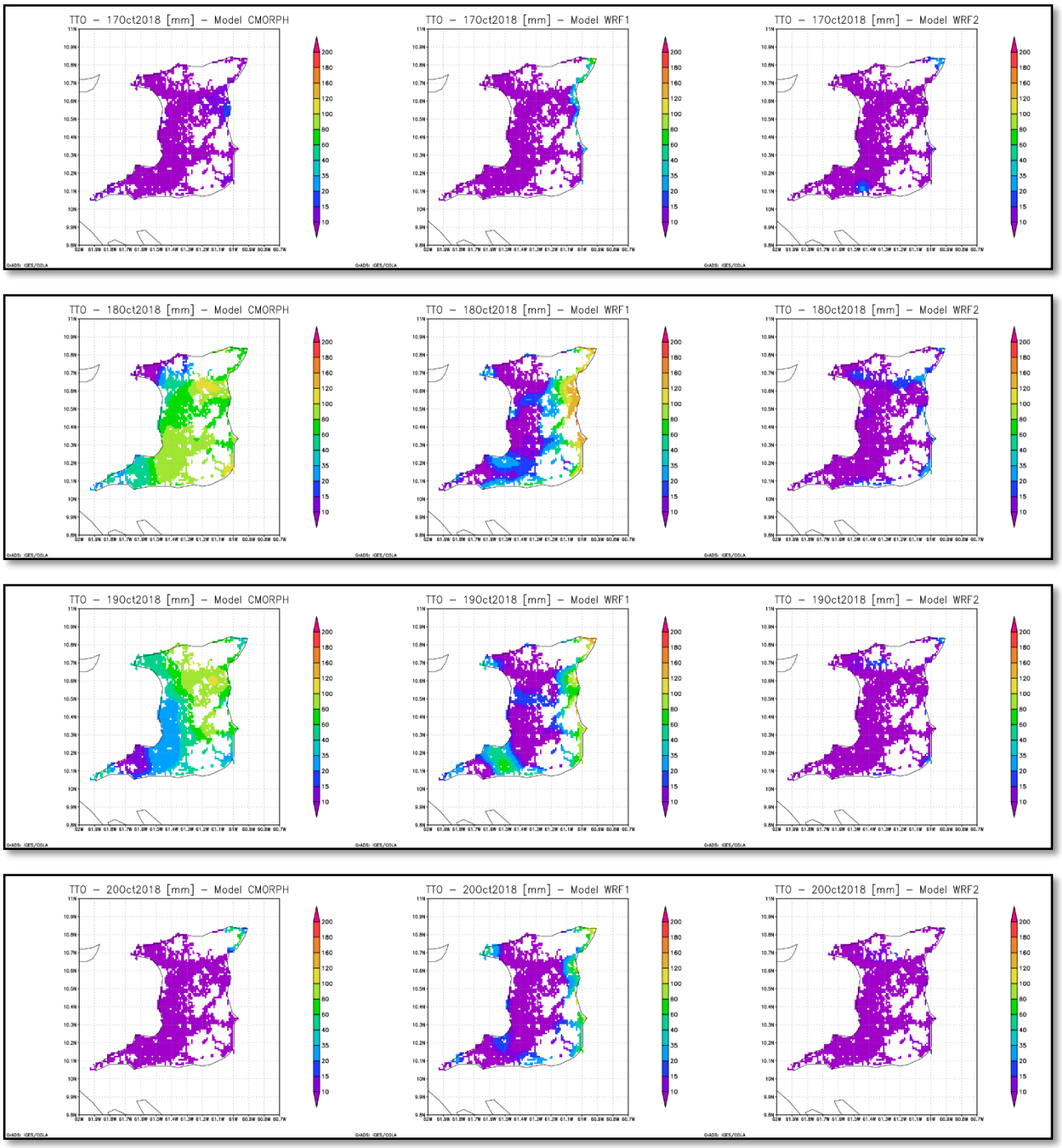


Figure 7 Accumulated precipitation (rainfall) at 1km resolution over Trinidad exposure on 17, 18, 19 and 20 October 2018 (from top to bottom) by CMORPH (left), WRF1 (centre) and WRF2 (right). Source: XSR Web.

The highest Rainfall Index Loss (RIL) was produced by CMORPH (RIL_{CMORPH} = US$61,753,187.13).Despite CMORPH simulating lower peaks of precipitation than WRF1, it reported high precipitation values also in western Trinidad, where the exposure is denser. WRF1 produced a lower RIL value (RIL_{WRF1} = US$17,757,836.36), because the rainfall was localized in the eastern area (characterized by less dense exposure). Finally, WRF2 produced the lowest RIL value (RIL_{WRF2} = US$179,543.67), due to the low amount of precipitation simulated over Trinidad.

CMORPH and WRF1 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$39,755,511.75) is equal to the average of the CMORPH and WRF1 RILs. The final RIL was higher than the policy attachment point for Trinidad's Excess Rainfall policy, and therefore this event was classified as a triggering event thus resulting in a payout.

5 TRIGGER POTENTIAL

The Rainfall Index Loss was calculated for this Covered Area Rainfall Event (CARE) that started on 18 October and ended on 20 October 2018, producing government losses which were above the attachment point of Trinidad's Excess Rainfall policy. Final calculations show that a payout of US$2,534,550.65 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.