Covered Area Rainfall Event (01/07/2024 to 02/07/2024)

Excess Rainfall

Event Briefing

Grenada

10 July 2024

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1 INTRODUCTION

This event briefing describes the impact of rainfall on Grenada, which was associated with a Covered Area Rainfall Event (CARE) starting on 1 July and ending on 2 July 2024. The Rainfall Index Loss (RIL) for the Covered Area Rainfall Event was above the attachment point of the Excess Rainfall policy of Grenada, and therefore a payout of $ 548,850.00 is due.

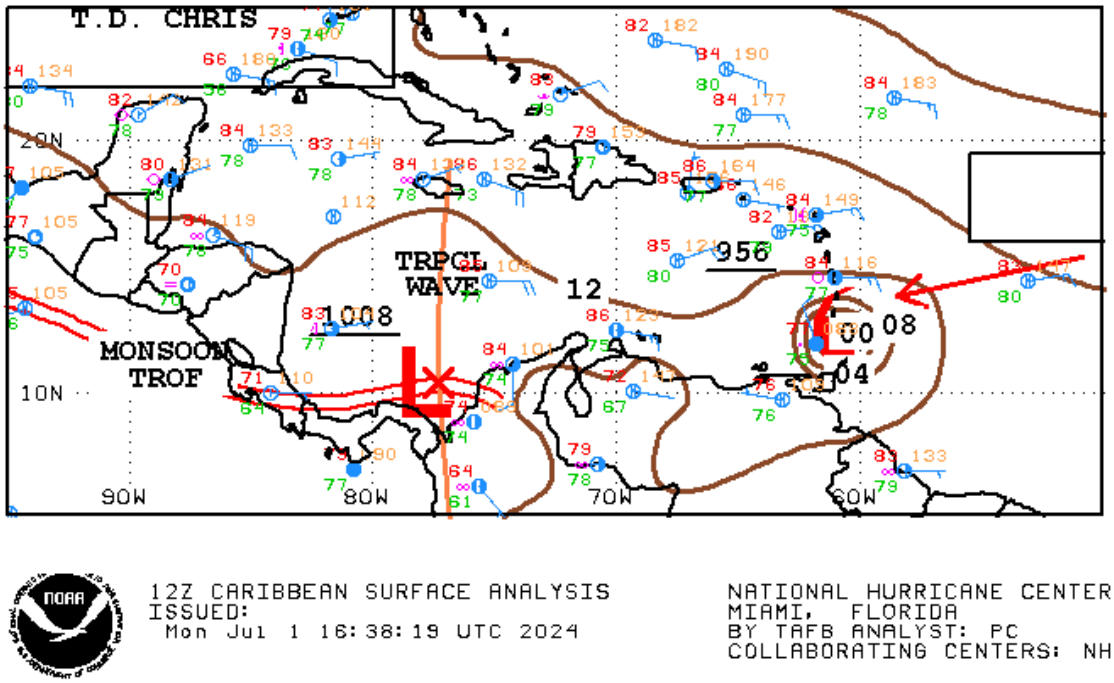
2 EVENT DESCRIPTION

On 29 June at 0300UTC, the US National Hurricane Center (NHC) reported that a tropical storm formed in the central tropical Atlantic Ocean, and it was named Beryl. The system proceeded westward with estimated forward velocity of 18 mph (30 km/h), along the southern periphery of a strong subtropical ridge. In the next 30 hours, the tropical storm rapidly intensified due to the low wind shear, the high moisture content and the warm surface temperature over the tropical Atlantic. On 29 June at 2100UTC it became a hurricane and on 30 June at 1530UTC, it evolved into a Category 4 hurricane, as reported by NHC. At this time, the centre of Beryl was sited near latitude 10.8° North, longitude 54.9° West, about 350 mi (565 km) ESE of Barbados, and it continued towards the Windward Islands with almost unvaried forward velocity and direction. The maximum sustained winds were estimated at 130 mph (215 km/h) and the minimum central pressure at 962 mb.

During the final hours of 30 June and the first hours of 1 July, despite the environmental conditions that were still supportive for the intensification of the hurricane, an eyewall replacement cycle hindered the further strengthening of the system. Indeed, a new outer eye formed outside the small inner core, weakening the latter and gradually becoming dominant. For this reason, when Beryl started to affect the Windward Islands with tropical-storm conditions, in the first hours of 1 July, it had weakened to a Category 3 hurricane, with maximum sustained winds estimated at 120 mph (195 km/h). During this time, Beryl passed over the waters between Barbados and Tobago, spreading tropical-storm conditions over these islands, and moved towards Grenada (Figure 1). At 0900UTC, the western outer rainband of the hurricane passed rapidly over Grenada, bringing locally intense rainfall over the country (Figure 3a).

Three hours later, at 1200UTC, Hurricane Beryl strengthened again, due to the completion of the eye replacement cycle and it became a Category 4 hurricane again. Satellite imagery showed the solid ring of deep convection surrounding the warming, well-defined eye of the hurricane (Figure 2). At this time, the precipitation associated with the hurricane's core started to affect Grenada (Figure 3b). In the following three hours, the precipitation became progressively more intense over Grenada, as the hurricane centre neared the country, and at about 1500UTC, the NHC reported that Beryl made landfall on Carriacou (Grenada). At this time, the heavy rainfall associated with the eyewall was brushing the northern coast of Grenada (Figure 3c). During the next three to six hours, Grenada experienced constantly moderate to locally intense precipitation as the eastern quadrant of the hurricane, the portion characterized by the heaviest rainfall, passed over the country (Figure 3d). Finally, at 2100UTC, Beryl moved away from the southern Windward Islands, and the associated rainfall ceased over Grenada. The hurricane continued to proceed west-northwestwards

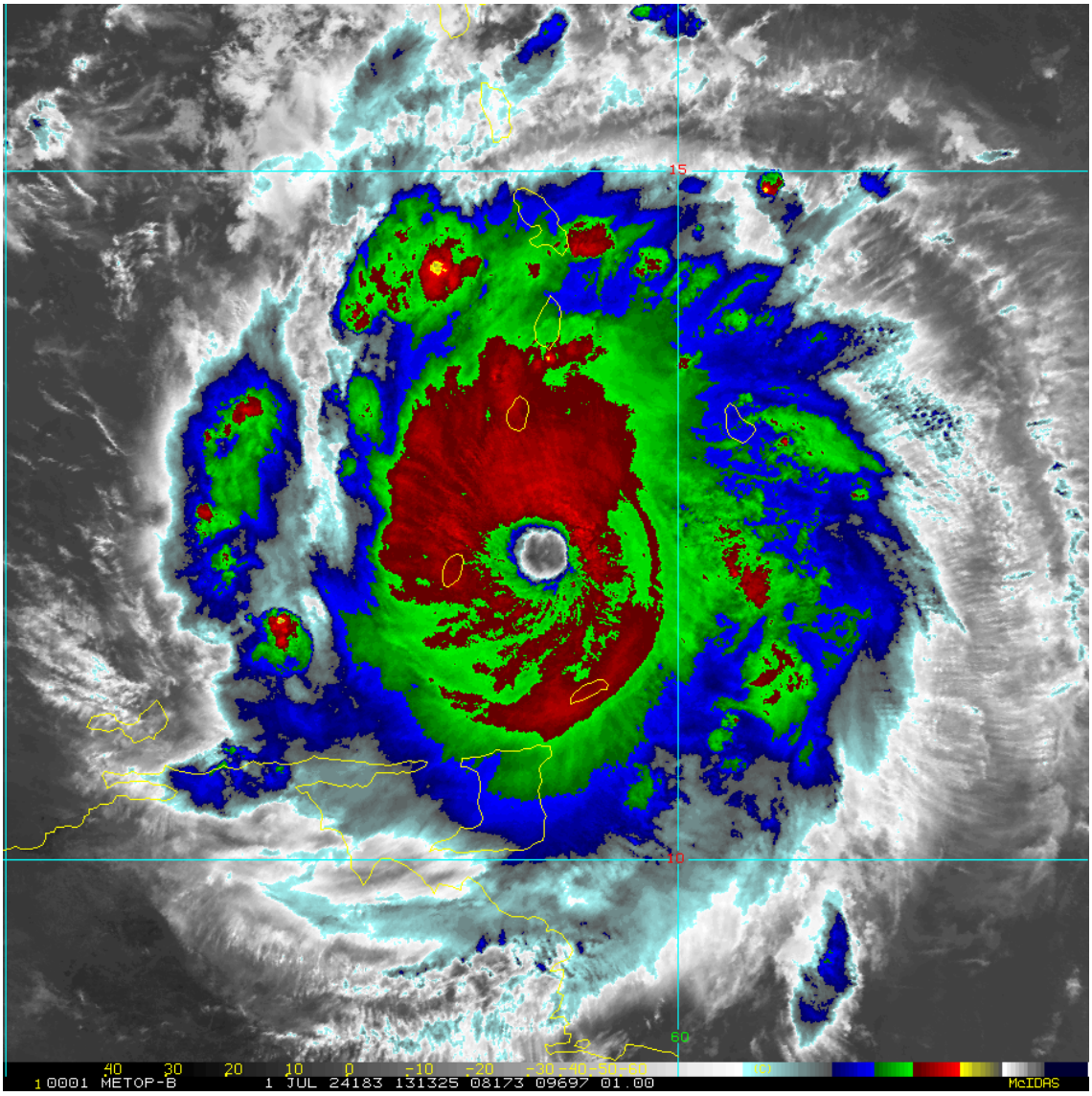
at almost 20 mph (31km/h), towards the central Caribbean Sea.



01 July at 1200UTC

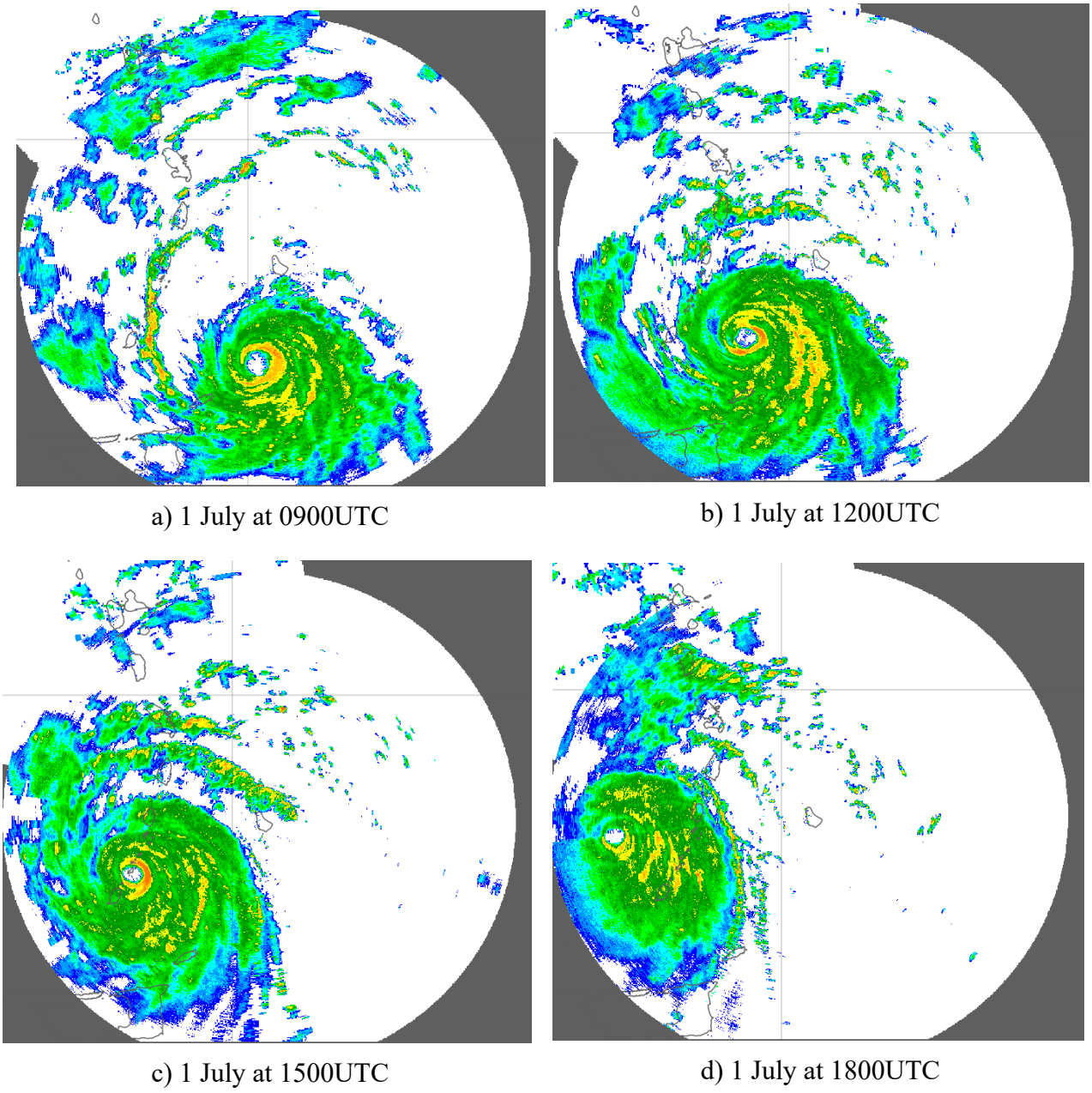
Figure 1 Surface analysis over the Caribbean area on 1 July 2024 at 1200UTC. Source: US National Hurricane Center[1]

1 National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review date: 1 July 2024, available at: *https://www.nhc.noaa.gov/tafb/CAR_12Z.gif*



01 July at 1313UTC

Figure 2 Satellite imagery on 1 July, 2024 at 1313UTC from the thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C and -70°C), while the red/yellow colours represent very high altitude clouds (top cloud lower than -70°C). High altitude clouds indicate strong convection associated with intense precipitation. Source: NOAA, National Environmental Satellite, Data and Information Service .



a) 1 July at 0900UTC

b) 1 July at 1200UTC

c) 1 July at 1500UTC

d) 1 July at 1800UTC

Figure 3. Radar imagery on 1 July, 2024, at different times as indicated in the labels from the radar composite over the Caribbean and Central America region. Blue/green colours represent low to moderate rainfall, while the yellow/red colours represent intense and very intense precipitation. Source: Barbados Radar Composite[2].

2 Barbados Radar Composite, available on 1July at:
https://www.barbadosweather.org/BMS_Radar_Composite_Resp.php#

3 REPORTED IMPACTS

At the time of writing this report, several sources of information reported damages or losses in Grenada due to this Covered Area Rainfall Event during the indicated period.

Beryl raged through the Eastern Caribbean on 01 July, with the eye passing over Carriacou. Heavy rains and dangerous storm surge have been reported and caused significant loss and damage to homes, public buildings, and sea vessels in the three-island state of Grenada, Carriacou and Petite Martinique.[3] According to a report from ReliefWeb, Grenada confirmed four deceased persons. [4]

Figure 4 Rubble strewn streets of Hillsborough, Carriacou. / Caribbean Loop News / Alvin Cudjoe on FB

Satellite imagery showed flattened houses and buildings without roofs. Grenada´s islands of Carriacou and Petite Martinique bore the brunt of the damage. Officials said roughly 98 percent of the islands' buildings had been destroyed. [5]

The top U.N. humanitarian official reported intense rains in Carriacou, which knocked out desalination plants, telecommunication towers and fiber optic cables, roads were impassable, also

[3] IOM: Hurricane Beryl barrels through Eastern Caribbean islands: IOM activates support | OIM Oficina Regional para Centroamérica, Norteamérica y el Caribe
[4] ReliefWeb: UNICEF Eastern Caribbean Area Office Situation Report No. 3 (Hurricane Beryl): 09 July 2024 - Grenada | ReliefWeb
[5] NY Times: Satellite Images Capture Beryl's Destruction in Carriacou and Petite Martinique - The New York Times (nytimes.com)

dwellings were destroyed along with local businesses and other income-generating activities. [6]

4 RAINFALL MODEL OUTPUTS

All data sources used by the XSR 3.0 model, CMORPH, IMERG, WRF5, WRF7, WRF11 and WRF15[7], detected the occurrence of precipitation over Grenada and the surrounding waters during the period 29 June to 02 July 2024. Each data source reported a specific distribution and accumulation of rainfall, as discussed below and shown in Figure 4. A CARE for Grenada was activated on 01 July and lasted until 02 July. The CARE was activated due to the use of the 12-hour and the 48-hour aggregation intervals for precipitation[8] and thus the period considered by the XSR 3.0 model for the loss estimate based on the accumulated precipitation in Grenada was 29 June to 02 July.

CMORPH reported total accumulated values of precipitation in the range between 100 mm and 125 mm over most of Grenada. Lower values, between 75 mm and 100 mm, were reported over a limited area of the parish of Saint John.

IMERG reported total accumulated values of precipitation in the range between 125 mm and 150 mm over most of Grenada. Lower values, between 100 mm and 125 mm, were reported over the northern portion of the island of Grenada and the smaller islands to the north, including Carriacou.

WRF5 showed total accumulated precipitation values higher than 125 mm over most of Grenada, with the maximum values, between 175 mm and 225 mm, in the parishes of Saint Andrew and Saint David. Lower values, between 75 mm and 125 mm, were reported over the southern edge of Grenada.

WRF7 reported total accumulated precipitation values higher than 100 mm over most of Grenada, with the maximum values, between 125 mm and 150 mm, in the parishes of Saint Andrew, Saint George and Saint David and over Carriacou. Lower values, between 75 mm and 100 mm, were reported over the northern edge of the island of Grenada.

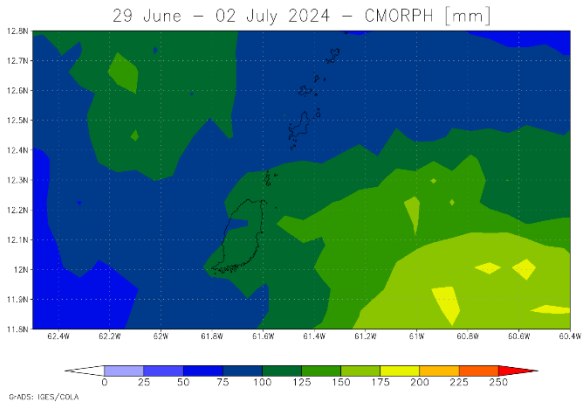
[6] Independent: Grenada minister tells UN: hurricane-devastated Islands need anything for `a human being to survive' | The Independent

7 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 are provided in the Definitions section of this report IMERG Model: The satellite-based rainfall estimation model developed by NASA, expressed in mm, derived by aggregating the IMERG 30-minute Rainfall Data at 10km spatial resolution and available at *https://jsimpsonhttps.pps.eosdis.nasa.gov/imerg/late*. Further details in the Definitions section of this reportWRF5,
WRF7, WRF11 and WRF15 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 are provided in the Definitions section of this report.

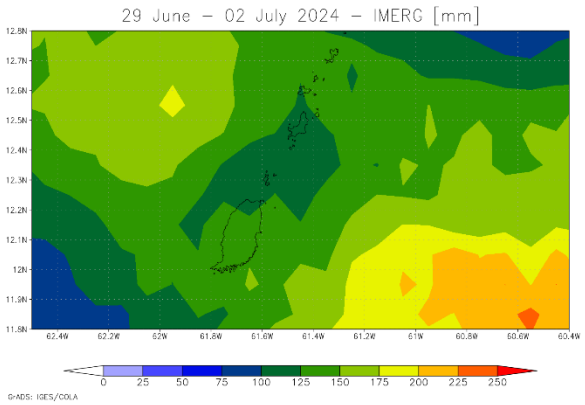
8 The two aggregation periods correspond to the Rainfall Aggregation Period #1 and Rainfall Aggregation Period #2, as indicated in the Schedule. Further details in the Definitions section of this report.

WRF11 showed total accumulated values of precipitation lower than the other models over the island of Grenada, with values under 50 mm on the southern part of the island and between 50 mm and 100 mm over the northern portion and over Carriacou. Higher values, in the range between 125 and 150 mm, were reported over Ronde Island and the surrounding waters.

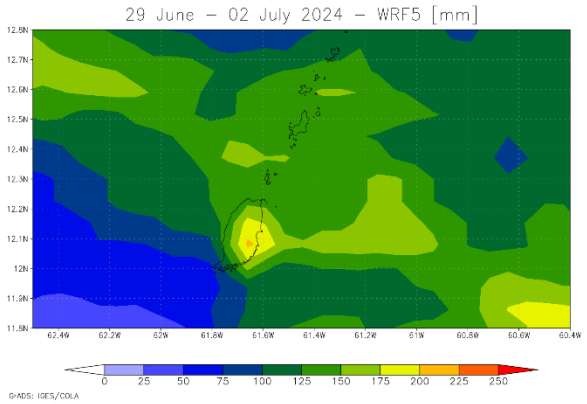
WRF15 reported accumulated values of precipitation higher than 75 mm over the centre of Grenada, with maximum values between 125 mm and 150 mm. Lower values, between 50 mm and 100 mm, were reported over the rest of the country.



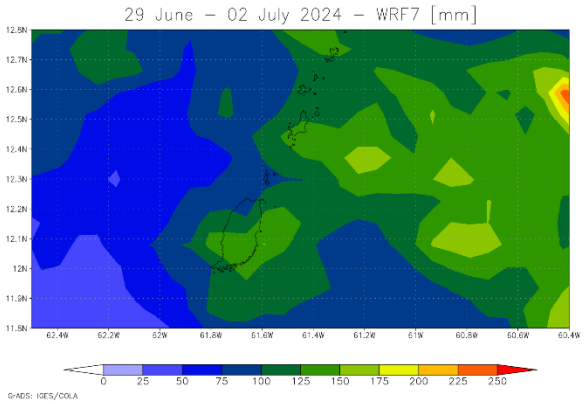
a) CMORPH



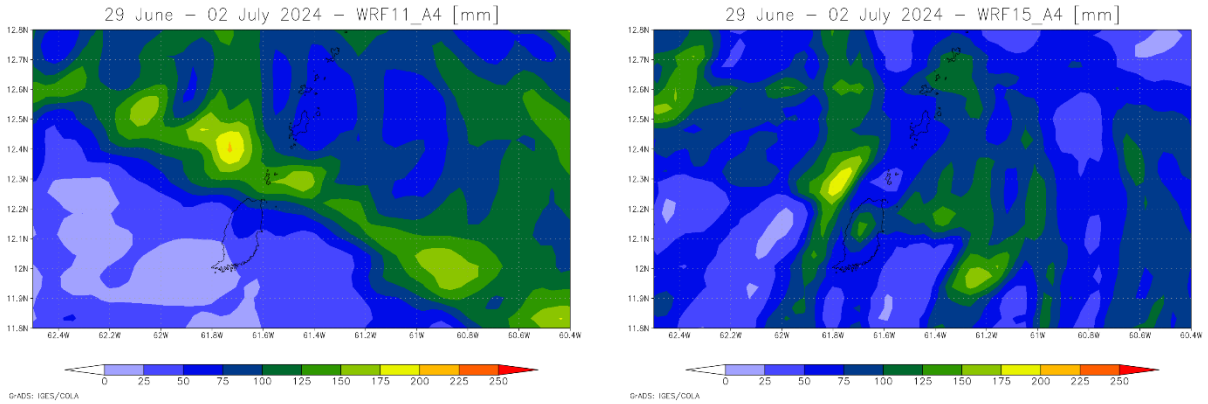
b) IMERG



c) WRF5



d) WRF7



e) WRF11 f) WRF15

Figure 5 Total accumulated precipitation during the period 29 June and 02 July, 2024 estimated by CMORPH (a), IMERG (b), WRF5 (c), WRF7 (d), WRF11 (e), WRF15 (f). Source: CCRIF SPC

Daily rainfall maps by CMORPH, IMERG, WRF5, WRF7, WRF11 and WRF15 over the exposure map of XSR 3.0 are not included here and they can be downloaded at the following links for 12-hour aggregation and 48-hour aggregation respectively:

https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/GRD/CARE_1_2024/daily_prec_short.mp4
https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/GRD/CARE_1_2024/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Grenada's Excess Rainfall policy for all the data sources used by XSR3.0: CMORPH, IMERG, WRF5, WRF7, WRF11, and WRF15. The RIL was the highest for WRF7.

The final RIL (RIL_{FINAL}) was calculated as the average of the RILs from six data sources. The RIL_{FINAL} was greater than the attachment point of the Excess Rainfall policy for Grenada and therefore this CARE qualified as a triggering event. Therefore, a payout is due under this Excess Rainfall policy to the Government of Grenada.

The Wet Season Trigger (WST) endorsement of the XSR3.0 model did not identify this CARE as a "Wet Season" event[9]. Therefore, no payout is due under the Wet Season Trigger endorsement of Grenada's Excess Rainfall policy.

9 The WST endorsement is designed to provide a predetermined payout for rainfall events occurring amidst already saturated soil conditions, effectively capturing the heightened risk of flooding and landslides. It is activated based on two factors: the Wet Index (the average 1-month Standardized Precipitation Index for all grid cells in the country) and Wet Periods (the period of time where the Wet Index exceeds 1, which indicates that the soil is wetter than its long-term average and serves as an indicator of soil saturation). The WST policy endorsement provides a payment when one or more CAREs with a modelled loss greater than zero occur within a Wet Period and the corresponding value of the Wet Index during the Wet Period exceeds a predetermined threshold.
Wet event (WE) is any period of consecutive days, during which the Wet Index (WI) is equal or greater than 1

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for the Covered Area Rainfall Event (CARE) for Grenada that started on 01 July and ended on 02 July 2024, produced government losses that were above the attachment point of Grenada's Excess Rainfall policy and therefore, the policy was triggered. A payout of US$ 548,850.00 is due to the Government of Grenada under its Excess Rainfall policy

For additional information, please contact CCRIF SPC at: pr@ccrif.org

DEFINITIONS

Active Exposure Cell Percentage Threshold	The percentage of the total number of XSR Exposure Grid Cells within the Covered Area of the Insured, that must be exceeded to trigger a Covered Area Rainfall Event.
Active Exposure Grid Cells	The XSR Exposure Grid Cells for which in the same single day the Aggregate Rainfall #1 value computed using the CMORPH-based Rainfall Estimate equals or exceeds the Rainfall Event Threshold #1 or the Aggregate Rainfall #2 value computed using the CMORPH-based Rainfall Estimate equals or exceeds the Rainfall Event Threshold #2.
Aggregate Rainfall #1	The rainfall amount accumulated over the Rainfall Aggregation Period #1 (as defined in the Schedule) measured in millimeters (mm) in any of the XSR Exposure Grid Cells in the Covered Area of the Insured. For a given day and a Rainfall Aggregation Period #1 of n hours, the Aggregate Rainfall #1 is the maximum amount of rainfall accumulated over any of the n-hour windows that intersect the day itself considering a time interval of 3 hours.
Aggregate Rainfall #2	The rainfall amount accumulated over the Rainfall Aggregation Period #2 (as defined in the Schedule) measured in millimeters (mm) in any of the XSR Exposure Grid Cells in the Covered Area of the Insured. For a given day and a Rainfall Aggregation Period #2 of n hours, the Aggregate Rainfall #2 is the maximum amount of rainfall accumulated over any of the n-hour windows that intersect the day itself considering a time interval of 3 hours.
Calculation Agent	Entity charged with undertaking the primary calculation of the Rainfall Index Loss.
CMORPH-based Maximum Aggregate Rainfall #1	The maximum value during the Covered Area Rainfall Event of the Aggregate Rainfall #1 computed using the CMORPH-based Rainfall Estimates in any given XSR Exposure Grid Cell over the Covered Area of the Insured.
CMORPH-based Maximum Aggregate Rainfall #2	The maximum value during the Covered Area Rainfall Event of the Aggregate Rainfall #2 computed using the CMORPH-based 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 Rainfall Estimates using the XSR Rainfall Model. Parameters are drawn from XSR Exposure Grid Cells within the Covered Area of the Insured, 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 ReliefWeb (*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 (CARE) event will not be considered. The Disaster Alert description issued by ReliefWeb and/or its attached documentation must include specific reference to the CARE dates with a tolerance period of 2 calendar days.
Maximum Aggregate Rainfall #1	The highest value during a Covered Area Rainfall Event of the Aggregate Rainfall #1 amount in any of the XSR Exposure Grid Cells in the Covered Area of the Insured computed.
Maximum Aggregate Rainfall #2	The highest value during a Covered Area Rainfall Event of the Aggregate Rainfall #2 amount in any of the XSR Exposure Grid Cells in the Covered Area of the Insured computed.
Rainfall Event Threshold #1	Aggregate Rainfall #1 level as defined in the Schedule which should be exceeded to trigger an Active Exposure Cell.

Rainfall Event Threshold #2	Aggregate Rainfall #2 level as defined in the Schedule which should be exceeded to trigger an Active Exposure Cell.
Rainfall Aggregation Period #1	The number of hours over which the Aggregate Rainfall #1 is computed for all XSR Exposure Grid Cells during a Covered Area Rainfall Event.
Rainfall Aggregation Period #2	The number of hours over which the Aggregate Rainfall #2 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.
WRF5 Model	The weather research and forecasting rainfall model by NOAA with Configuration #5 data initialized with and assimilating the data provided 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.
WRF7 Model	The weather research and forecasting rainfall model by NOAA with Configuration #7 data initialized with and assimilating the data provided 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.
XSR Grid Cell Exposure Value	The value, used to calculate the CMORPH-based Exposure Grid Cell Loss, the WRF5-based Exposure Grid Cell Loss, and the WRF7-based Exposure Grid Cell Loss.