# Covered Area Rainfall Event (03/07/2024)

# Excess Rainfall

## Event Briefing

## Barbados

**12 July 2024**

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# 1 INTRODUCTION

This event briefing describes the impact of rainfall on Barbados, which was associated with a Covered Area Rainfall Event (CARE) on 3 July 2024. The Rainfall Index Loss (RIL) for the Covered Area Rainfall Event was below the attachment point of Barbados' Excess Rainfall policy, and therefore no payout is due to the Government of Barbados.

# 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. Thus, 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 proceeded 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.

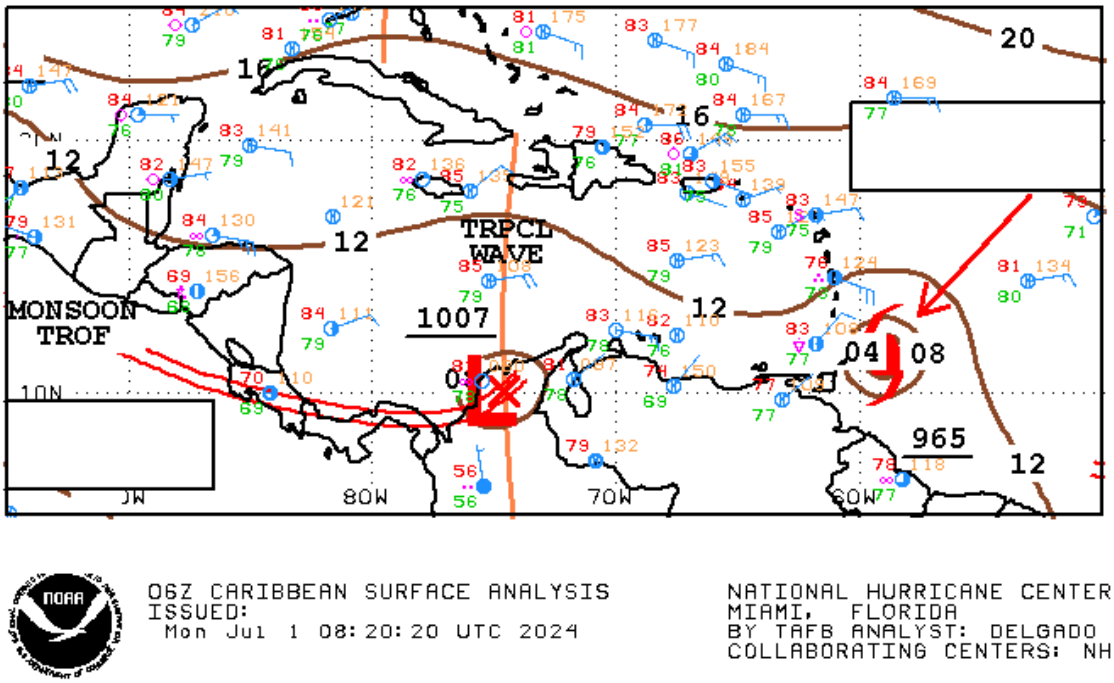
During the final hours of 30 June and the first hours of 1 July, despite the environmental conditions that were still supportive for the intensification of the hurricane, an eyewall replacement cycle hindered the further strengthening of the system. Indeed, a new outer eye formed outside the small inner core, weakening the latter and gradually becoming dominant. For this reason, when Beryl started to affect the Windward Islands with tropical-storm conditions, during 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)

Barbados was only partially affected by the heavy rainfall associated with Hurricane Beryl. Indeed, the radar maps showed that a first outer rainband passed rapidly over Barbados at around 0300UTC, bringing showers of moderate intensity over the country. Then, between 0600UTC and 1200UTC, Beryl passed over the waters between Barbados and Tobago (Figures 1a and 2a). At its closest distance, at 0900UTC, the centre of Beryl was sited at latitude 11.4° North, longitude 59.5° West, about 99 mi (160km) SSW of Bridgetown (Barbados), Figure 1a. The rainfall associated with the hurricane's core brushed the southern coast of Barbados from 0600UTC until 1200UTC, as visible from the radar maps (Figures 3a, 3b and 3c).

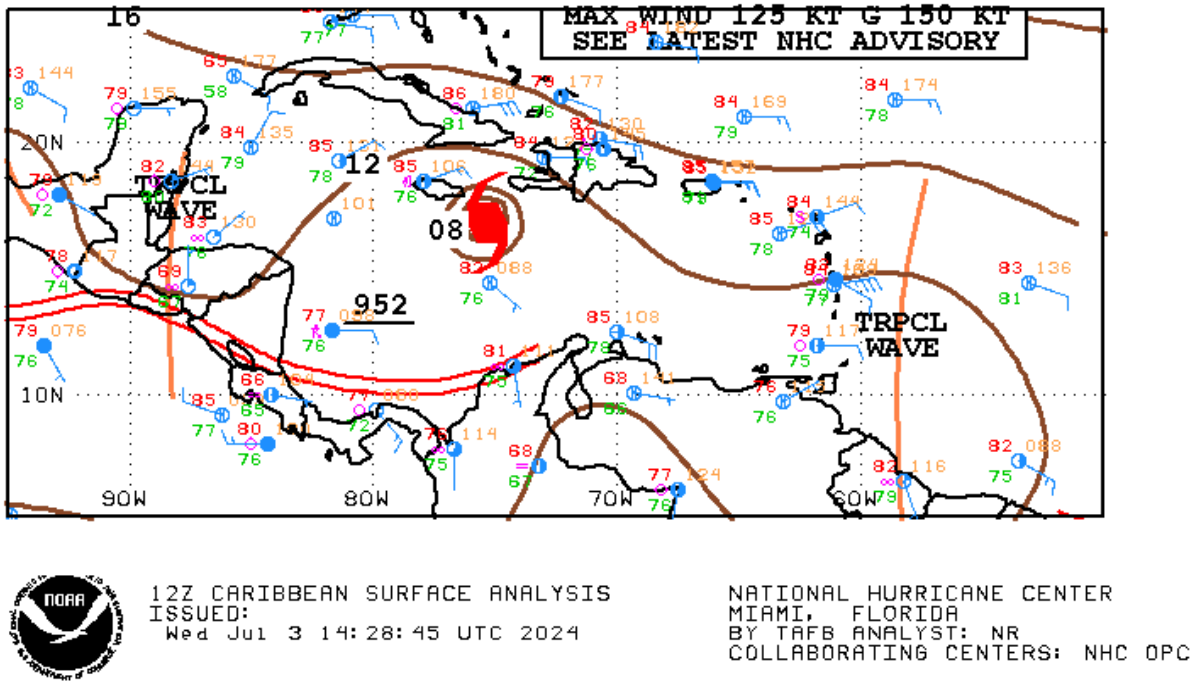
At 1200UTC, Hurricane Beryl strengthened again, due to the completion of the eye replacement cycle and became a Category 4 hurricane again. It proceeded north-northwestward moving towards Grenada. At 1500UTC, while the eye was making landfall over Grenada, the northeastern outer rainband of the hurricane passed rapidly in the vicinity of Barbados, bringing again scattered moderate to isolated intense precipitation over the country (Figure 3d).

Hurricane Beryl then moved away from the southern Windward Islands, proceeding west-northwestwards at almost 20 mph (31km/h), towards the central Caribbean Sea.

Two days later, on 3 July, when Hurricane Beryl was in the vicinity of Jamaica, a powerful tropical wave crossed the Lesser Antilles. At 1200UTC, its axis was near longitude 61°West, and it was moving very rapidly westward at 29-35 mph (46 -55 km/h), as visible in Figure 1b. The satellite imagery showed that scattered moderate to isolated strong convection developed ahead and in the vicinity of the tropical wave, over an extended area from latitude 10°North to 16°North, between longitude 57°West and 65°West (Figure 2b). In particular, a thunderstorm affected Barbados with moderate to heavy rainfall from 1100UTC until 1400UTC, as shown by the radar maps (Figures 3e and 3f).



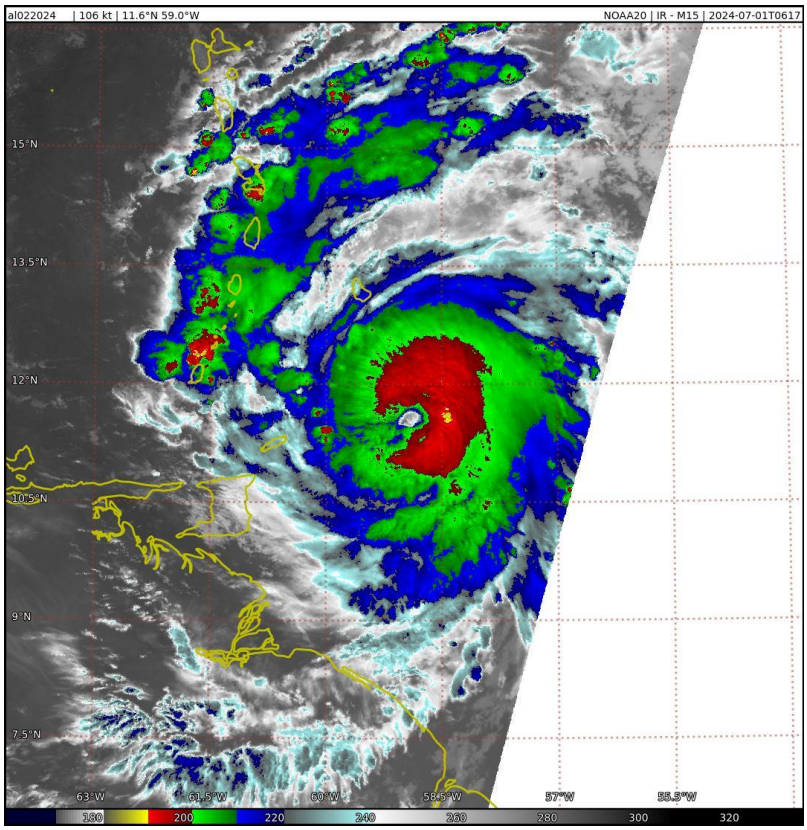

a) 01 July at 0600UTC



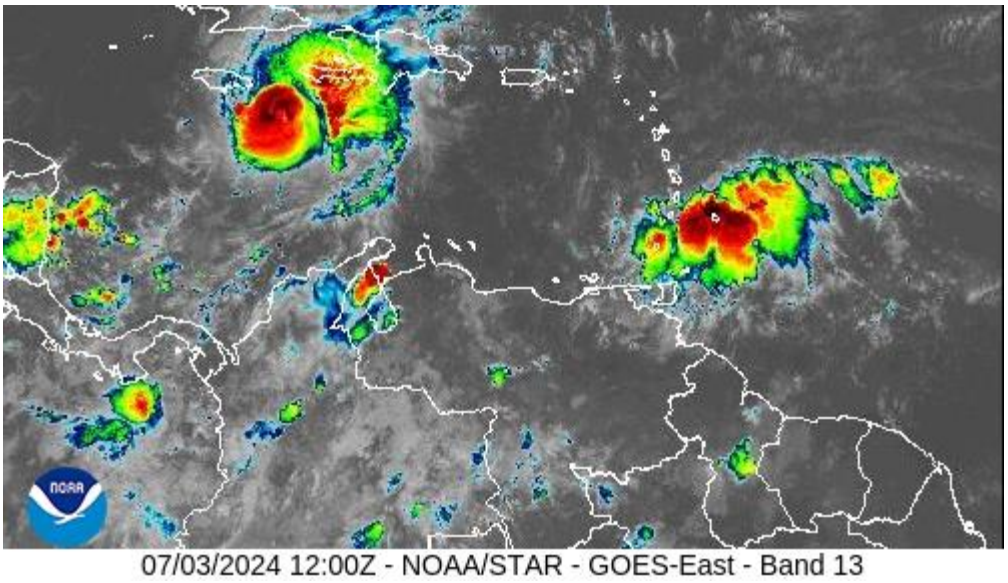

b) 03 July at 1200UTC

Figure 1 Surface analysis over the Caribbean area on 1 and 3 July 2024 at different times as indicated in the labels. Source: US National Hurricane Center[1]

1 National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review dates: 1 and 3 July 2024, available at: https://www.nhc.noaa.gov/tafb/CAR_06Z.gif, https://www.nhc.noaa.gov/tafb/CAR_12Z.gif,



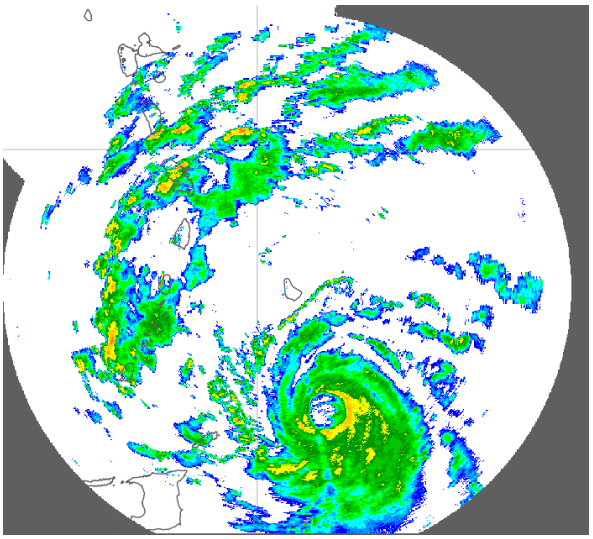

a) 01 July at 0617UTC



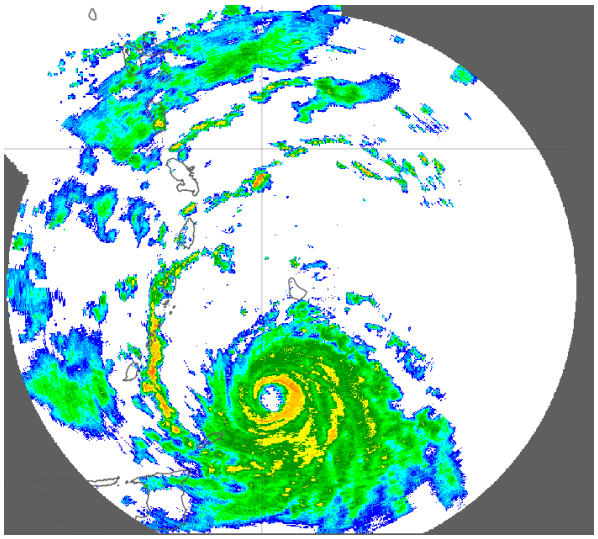

b) 3 July at 1200UTC

Figure 2 Satellite imagery on 1 and 3 July, 2024 at different times as indicated in the labels from the thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C

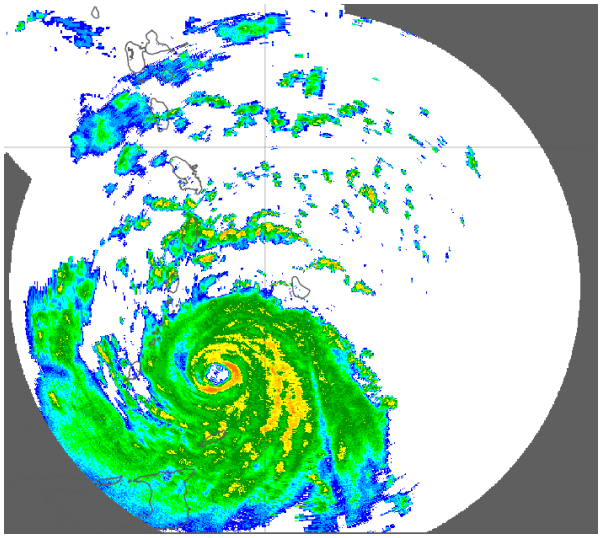
and -70°C), while the red/yellow colours represent very high altitude clouds (top cloud lower than -70°C). High altitude clouds indicate strong convection associated with intense precipitation. Source: NOAA, National Environmental Satellite, Data and Information Service[2].



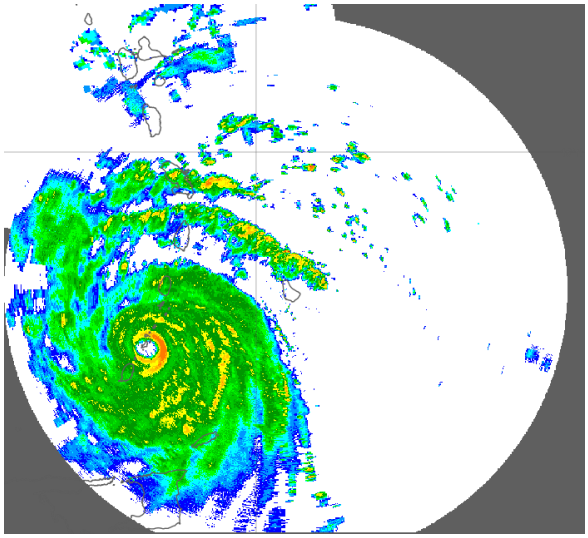
a) 1 July at 0600UTC



b) 1 July at 0900UTC

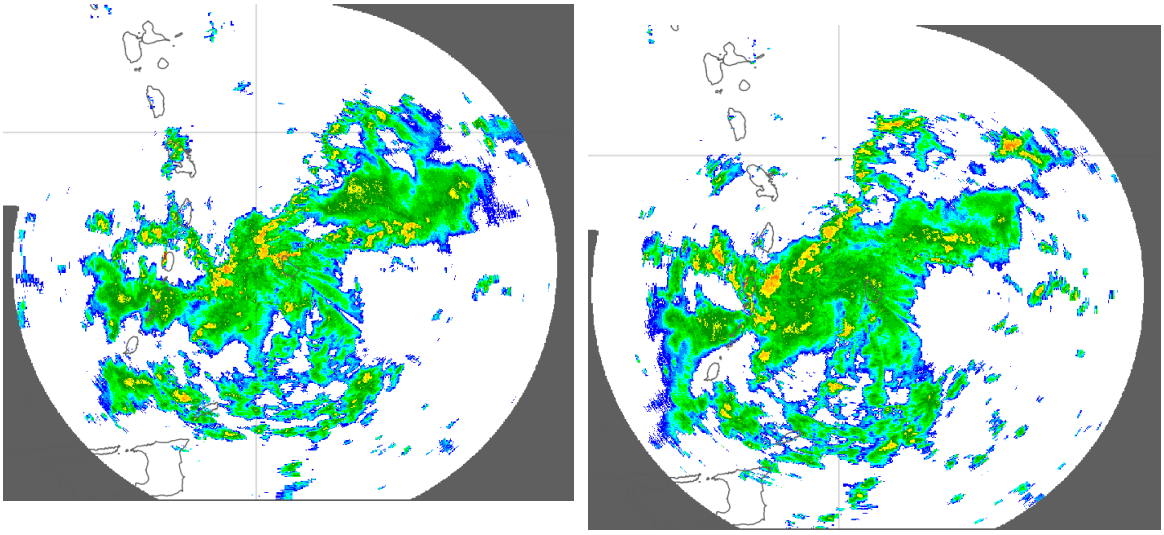


c) 1 July at 1200UTC



d) 1 July at 1500UTC

2 RAMSDIS Online Archive, NOAA Satellite and Information Service, available at: https://rammb-data.cira.colostate.edu/tc_realtime/storm.asp?storm_identifier=al022024, https://cdn.star.nesdis.noaa.gov/GOES16/ABI/SECTOR/cam/13/20241851200_GOES16-ABI-car-13-500x500.jpg



e) 3 July at 1200UTC

f) 3 July at 1300UTC

Figure 3. Radar imagery on 1 and 3 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[3].

## 3 REPORTED IMPACTS

At the time of writing this report, information reporting damages or losses in Barbados due to this Covered Area Rainfall Event during the indicated period is limited.

However, a flash-flood warning was in effect on 03 of July. There was excessive rainfall that could generate flooding across low-lying areas. [4]

The housing sector reported minimal damage, with Ministry of Housing assessments underway to support affected. Until 1 July, there were around 400 people in shelters.

Ministry of Agriculture installations sustained minimal damage, but crop damage included 20% of pawpaw and plantain fields and 35 acres of banana crops. Extension officers are currently assessing the damage. The tourism industry was also hit hard, with 73% of hotels, apartments, and guest houses reporting damage, though the pleasure cruise sector saw limited impact[5].

3 Barbados Radar Composite, available on 1 and 3 July at:
*https://www.barbadosweather.org/BMS_Radar_Composite_Resp.php#*
4 X: Barbados Met Services
5 Hurricane Beryl Update 3


Figure 4 Flooded streets in Hastings, Barbados. / Ricardo Mazalan/AP [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 Barbados and the surrounding waters during the period 1 to 3 July, 2024. Each data source reported a specific distribution and accumulation of rainfall, as discussed below and shown in Figure 3. A CARE for Barbados was activated on 3 July and closed the same day. 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

6 CNN Weather: Hurricane Beryl strengthens into the earliest Category 5 Atlantic storm on record after devastating Windward Islands | CNN

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 are in the Definitions section of this report.

considered by the XSR 3.0 model for the loss estimate based on the accumulated precipitation in Barbados was 1 to 3 July.

CMORPH reported total accumulated values of precipitation between 60 mm and 80 mm over most of Barbados. Higher values were reported along the southeastern coast between 80 mm and 100 mm over a small area in the parish of Saint Philip. Values lower than 60 mm were reported along the northern coast around the town of Crab Hill.

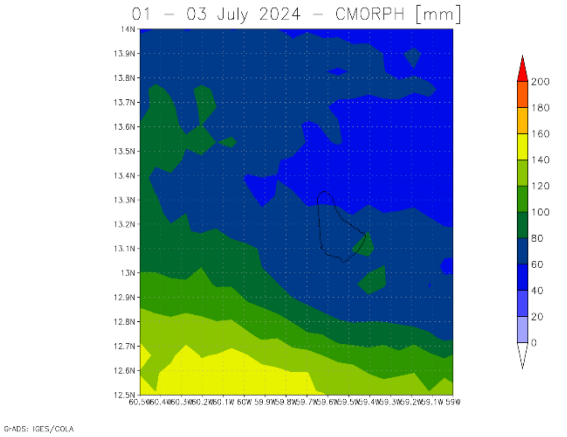
IMERG reported total accumulated values of precipitation higher than 80 mm over Barbados, with values increasing from north to south. The maximum values, between 140 mm and 160 mm, were reported along the southern coast.

WRF5 showed total accumulated values of precipitation between 40 mm and 120 mm over Barbados, with values increasing from west to east.

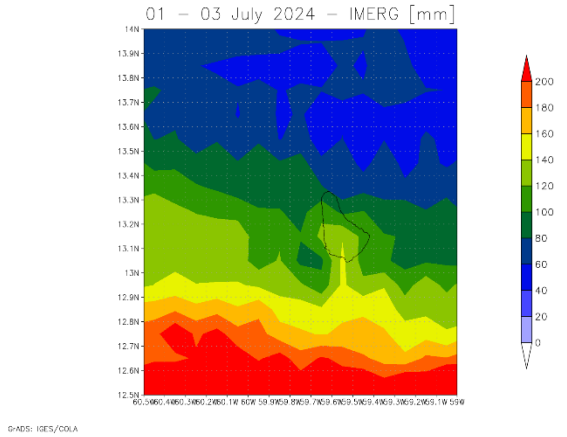
WRF7 reported total accumulated values of precipitation with a similar geographic distribution to that of WRF5, with values increasing from west to east and reaching the maximum values, between 120 mm and 140 mm, along the southwest coast.

WRF11 showed total accumulated values of precipitation higher than 100 mm over most of Barbados, with maximum values, between 120 mm and 140 mm, over the central and southeastern portions of the country. Lower values were reported over the rest of Barbados.

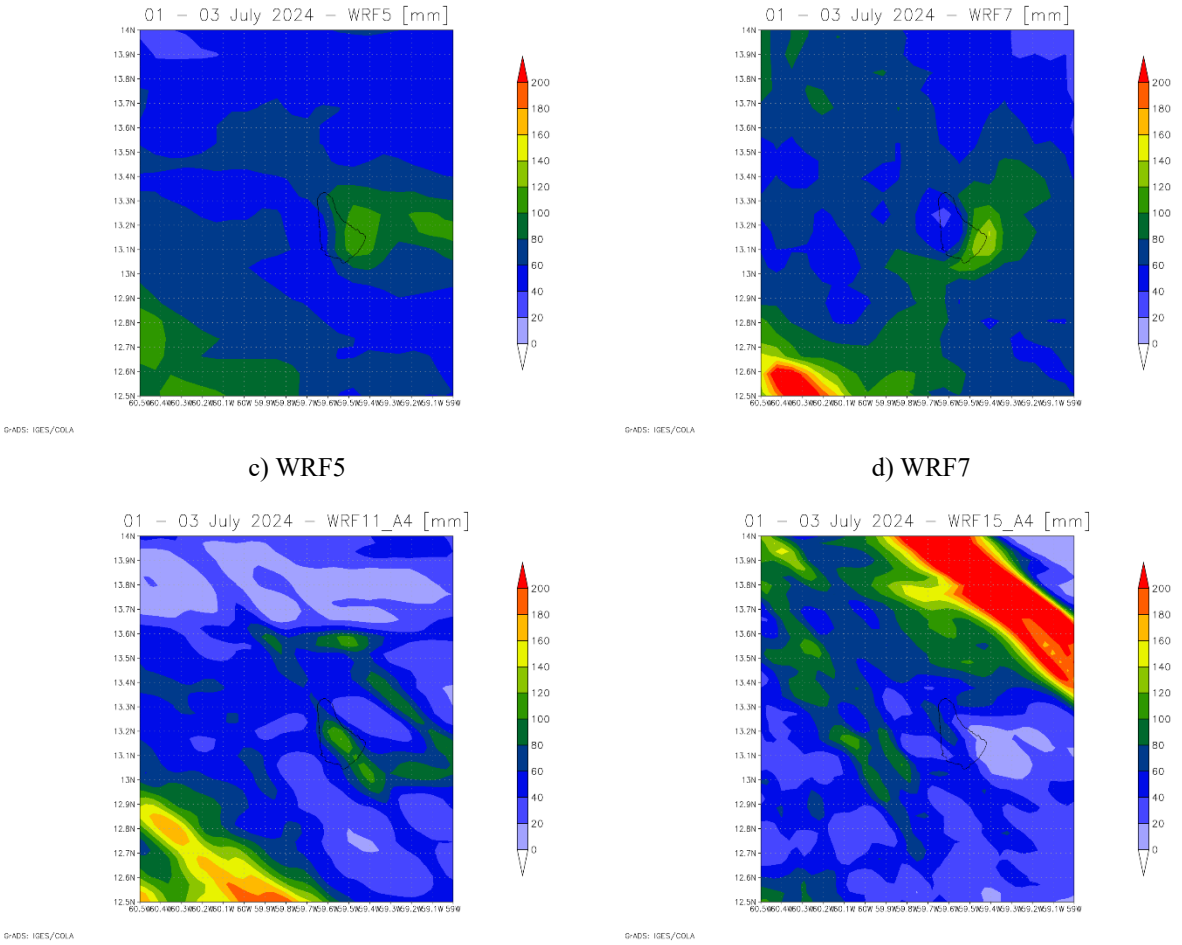
WRF15 reported total accumulated values of precipitation between 60 mm and 80 mm over the parishes of Saint James and Saint Thomas. Lower values were reported over the rest of Barbados.




a) CMORPH




b) IMERG




c) WRF5 d) WRF7

e) WRF11 f) WRF15

Figure 6 Total accumulated precipitation during the period 01 – 03 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/BRB/CARE_1_2024/daily_prec_short.mp4*

*https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/BRB/CARE_1_2024/daily_prec_long.mp4*

The Rainfall Index Loss (RIL) was below the loss threshold for Barbados' 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 WRF11. However, a Disaster Alert declaration with code 52063 was issued by ReliefWeb for Barbados related to Hurricane Beryl. Because of the Disaster Alert, the final RIL was calculated for this CARE, even though the RILs for the six data sources were below the threshold.

The final RIL ($RIL_{FINAL}$) was calculated as the average of the six RILs from CMORPH, IMERG, WRF5, WRF7, WRF11 and WRF15. The $RIL_{FINAL}$ was greater than zero and therefore this CARE qualified as a loss event. However, the $RIL_{FINAL}$ was below the attachment point of Barbados' Excess Rainfall policy, and thus the policy was not triggered. Therefore, no payout is due under this Excess Rainfall policy to the Government of Barbados.

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 Barbados' Excess Rainfall policy.

# 5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for the Covered Area Rainfall Event (CARE) for Saint Lucia was below the attachment point of the Excess Rainfall policy for this country, and therefore no payout is due. This CARE did not activate the Wet Season Trigger endorsement of the Excess Rainfall policy and therefore no payout under this endorsement is due.

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

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

**DEFINITIONS**

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|---|---|
| ***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. |