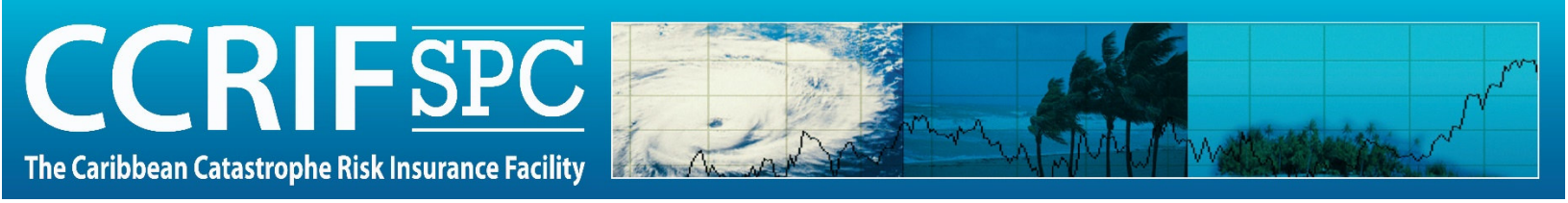

Covered Area Rainfall Event (30/06/2021 to 02/07/2021)

Excess Rainfall

Event Briefing

Barbados

9 July 2021

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1 INTRODUCTION

In the period between June 30 and July 2, 2021, the evolution, development and movement of a tropical wave and Tropical Cyclone Elsa generated adverse atmospheric conditions that caused thunderstorms and heavy rainfall over Barbados.

This event briefing describes the impact of rainfall on Barbados, which was associated with a Covered Area Rainfall Event (CARE), starting on 30 June and ending on 2 July 2021. The Rainfall Index Loss (RIL) indicated government losses above the attachment point of Barbados' Excess Rainfall policy. Final calculations show that a payout of US$1,124,424.00 is due to the Government of Barbados.

As reported in a separate tropical cyclone event briefing, "TC Elsa: Windward Islands" dated 4 July 2021, Barbados experienced maximum sustained winds near 75 mph (120 km/h) with higher gusts from the system. The final runs of the CCRIF SPHERA loss model for tropical cyclones produced losses due to wind and storm surge impacts, which were above the attachment point of Barbados' Tropical Cyclone policy and a payout of US$1,345,500.00 is due under that policy.

2 EVENT DESCRIPTION

On 30 June, a broad area of low pressure, associated with a tropical wave was reported to move to the west over the Atlantic. This phenomenon had a disorganized structure, producing a large area of showers and thunderstorms, and it continued to evolve through the next several hours as the system continued its movement approaching the Windward Islands.

Despite its disorganization, the following day, on 1 July, this tropical disturbance, previously named Potential Tropical Cyclone Five, was upgraded to Tropical Storm Elsa. Locally heavy rains were expected. On 2 July, the tropical storm developed into Hurricane Elsa, passing over several Eastern Caribbean countries (Figure 1 and Figure 2a). As expected, it brought locally heavy rainfall to portions of the Windward Islands, greatly affecting Barbados.

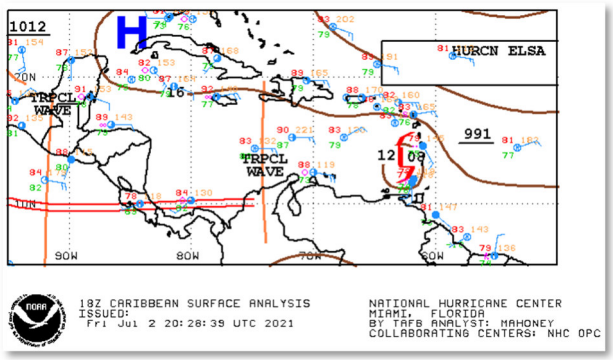
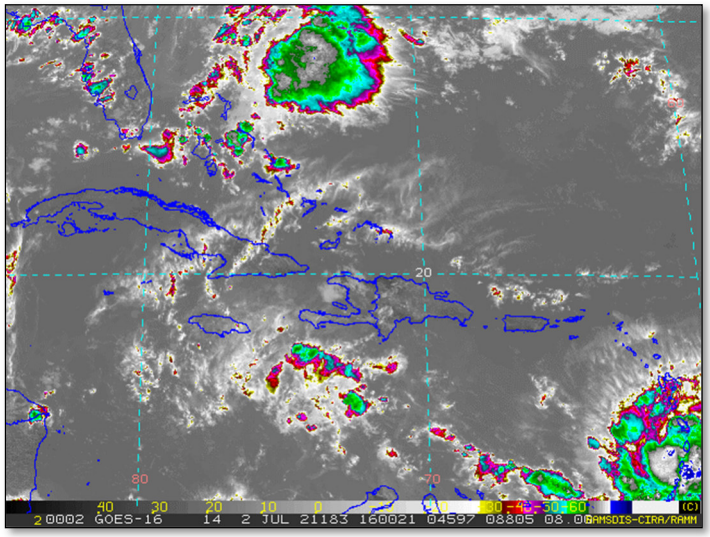


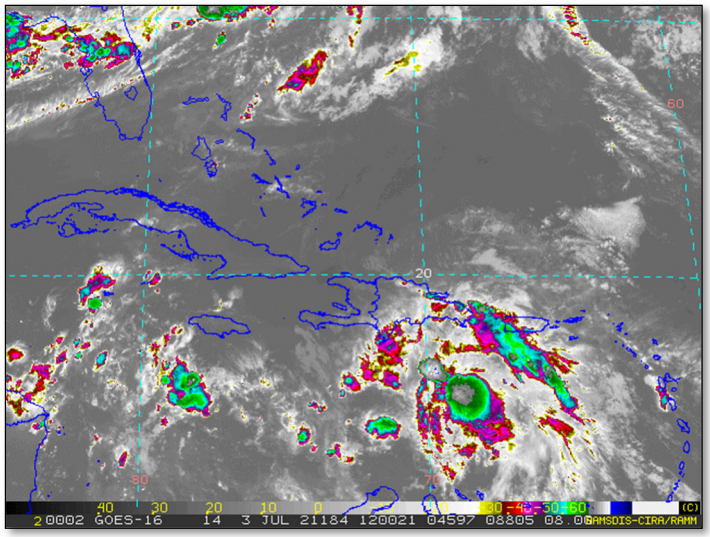
Figure 1 Surface analysis over the Caribbean area on 2 July at 20:28:39 UTC.
Source: US National Hurricane Center[1]

[1] National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review date: 3 July 2021, available at: https://www.nhc.noaa.gov/tafb/CAR_18Z.gif

During the next several hours, Hurricane Elsa continued moving to the west-northwest heading to the eastern Caribbean Sea (Figure 2b), resulting in the end of heavy rainfall activity over countries of Windward Islands.



a) 2 July 2021 at 1600UTC



b) 3 July 2021 at 1200UTC

Figure 2 Satellite imagery at different times as indicated in the labels from 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 Satellite and Information Service[2]

[2] RAMSDIS Online Archive, NOAA Satellite and Information Service, available at:
https://rammb.cira.colostate.edu/ramsdis/online/images/rmtc/rmtcsasec4ir404/rmtcsasec4ir404_20210702160021.gif
https://rammb.cira.colostate.edu/ramsdis/online/images/rmtc/rmtcsasec4ir404/rmtcsasec4ir404_20210703120021.gif

3 IMPACTS

Barbados' Minister of Home Affairs, Information and Public Affairs, Wilfred Abrahams, reported that "We have been significantly affected. There is widespread damage to property. There are roofs that have come off, roofs have collapsed, houses have collapsed. There are downed power lines across Barbados, live power lines, downed trees, some roads are impassable". Barbados' Prime Minister, Mia Amor Mottley, reported that there was no loss of life or major injuries caused by the passage of Tropical Storm Elsa.

The entire country was affected in some way by wind and rainfall due to Tropical Storm Elsa, with the most significant impacts due to wind. According to the assessments provided by the Caribbean Disaster Emergency Management Agency (CDEMA)[3] and media news[4] [5], the impact in Barbados was reported as described below:

- 1,233 houses were damaged; 114 collapsed
- several schools and government buildings were damaged
- there were 74 downed trees
- there were 27 downed electricity poles and wires
- there were 4 gas leaks

Prior to the arrival of Tropical Storm Elsa, Barbados' authorities took precautionary measures such as activating the National Emergency Operations Centre (NEOC). Also as a precautionary measure, essential businesses were closed. Six shelters were opened, which were used by a total of 34 occupants.

4 RAINFALL MODEL OUTPUTS

All three data sources used by the XSR 2.5 model, CMORPH[6], WRF5 and WRF7[7], detected the occurrence of precipitation over Barbados and the surrounding waters during the period 30 June – 02 July 2021. However, each data source reported a specific distribution of rainfall, as discussed below and shown in Figure 3.

[3] Caribbean Disaster Emergency Management Agency (CDEMA), Situation Report No. 3 (As of 4:00 PM on July 6, 2021), review date: 6 July 2020, available at: *Tropical Storm Elsa*

[4] CBC Radio-Canada, review date: 4 July 2021, available at: '*Tropical storm Elsa leaves at least 3 dead in Caribbean, heads toward Cuba, Florida*'

[5] Emergency Response Coordination Centre (ERCC), review date: 4 July 2021, available at: '*The Caribbean - Hurricane ELSA*'

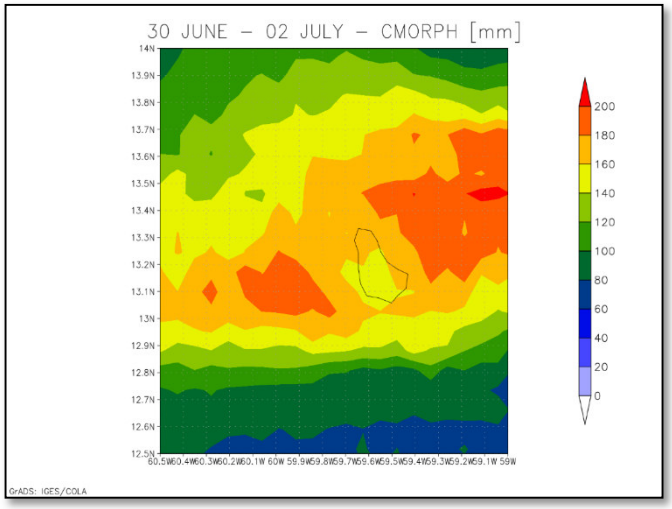
[6] CMORPH Model: the satellite-based rainfall precipitation estimates provided by the NOAA Climate Prediction Center (CPC) using the so-called Morphing Technique *http://www.cpc.ncep.noaa.gov/products/janowiak/cmorph_description.html*. Further details in the Definitions section of this report.

[7] WRF5 and WRF7 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.

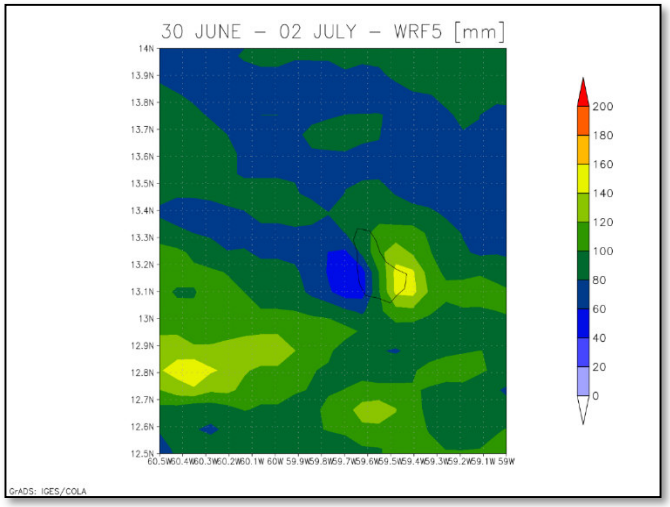
CMORPH reported total accumulated amounts of precipitation of about 160 mm over most parts of Barbados. Slightly higher precipitation was presented over the northern and southwestern areas with values of 180 mm.

WRF5 simulated total accumulated amounts of rainfall with different values over the whole country. The values increased gradually from the eastern to the western part of Barbados, with the lowest value of 40 mm on the east and the highest value of 160 mm on the southwestern part of the country.

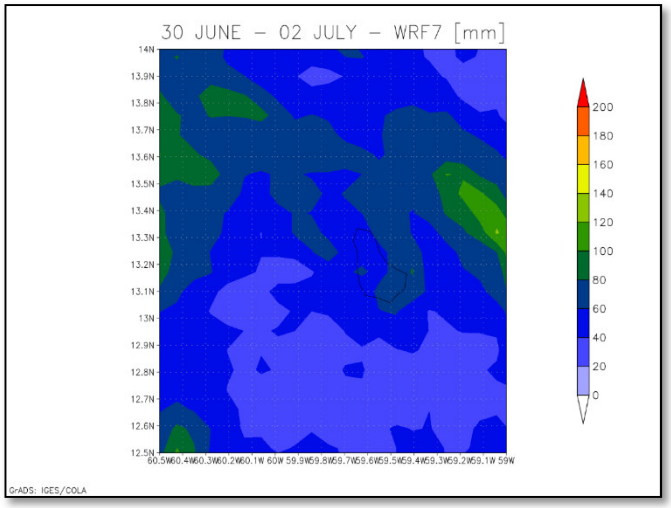
On the other hand, total accumulated amounts of precipitation presented on WRF7 showed lower values than the previous two models. The precipitation was below 100 mm for the entire country. According to the simulation, the amount of precipitation was approximately 40 mm for most parts of Barbados except on the southwest where the precipitation was 60 mm.



a) CMORPH



b) WRF5



c) WRF7

Figure 1 Total accumulated precipitation during the period 30 June – 2 July, 2021 estimated by CMORPH (a), WRF5 (b) and WRF7 (c). Source: CCRIF SPC

Daily rainfall maps by CMORPH, WRF5 and WRF7 over the exposure map of XSR 2.5 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_2_2021/daily_prec_short.mp4

https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/BRB/CARE_2_2021/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Barbados for one data source used by XSR2.5: CMORPH, while the RIL was below the loss threshold for this country for both WRF7 and WRF5.

Consequently, the final RIL (RIL_{FINAL}) was equal to the RIL from CMORPH (since it was the only data source with an RIL above the loss threshold). The RIL_{FINAL} was higher than the attachment point of the Excess Rainfall policy for Barbados, and therefore this event was classified as a triggering event thus resulting in a payment.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) that started on 30 June and ended on 2 July 2021, produced government losses which were above the attachment point of Barbados' Excess Rainfall policy. Final calculations show that a payout of US$1,124,424.00 is due to the Government of Barbados.

CCRIF expresses sympathy with the Government and people of Barbados for the impacts on communities and infrastructure caused by this event.

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.