CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

Covered Area Rainfall Event (17/09/2022 to 19/09/2022)

Excess Rainfall

Event Briefing

Antigua and Barbuda

28 September 2022

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1 INTRODUCTION

This event briefing describes the impact of rainfall in Antigua and Barbuda, which was associated with a Covered Area Rainfall Event (CARE), starting on 17 September and ending on 19 September 2022. The Rainfall Index Loss (RIL) was above the attachment point of Antigua and Barbuda's excess rainfall policy and a payout of US$420,645.00 is due.

2 EVENT DESCRIPTION

On 14 September at 0150 UTC, the US National Hurricane Center (NHC) reported that a Tropical Storm named Fiona developed from a tropical depression located over the western central Atlantic Ocean. Its centre was approximately sited near latitude 16.8° North, longitude 52.0° West, about 640 mi (1030 km) E of the Northern Leeward Islands. The minimum central pressure was 1002 mb and the maximum sustained winds were estimated at 50 mph (85 km/h). The system moved towards west with the estimated forward velocity of 14 mph (22 km/h). The storm was affected by a moderate to strong westerly-northwesterly wind shear, which caused the misalignment of the low-level circulation centre with the main convective mass. This feature persisted in the next two days and hindered a fast intensification of the system. Moreover, along its track towards the Northern Leeward Islands, Fiona went through a region characterized by dry air, which further interfered with the system strengthening.

The intensity and features of Tropical Storm Fiona were almost unchanged on 16 September at 2100 UTC, when the system centre was located about 20 mi (35 km) E-NE of Guadeloupe (16.4°N, 61.1°W). In the next 12 hours, Fiona continued to move westward. During this period, its centre made landfall over Guadeloupe and, afterwards, it passed over the waters to the south of Antigua and Barbuda, Montserrat and Saint Kitts and Nevis (Figure 1). Due to a gradual air moistening, the environmental conditions began to be slightly more favourable for the intensification of the storm, and the maximum sustained winds increased to 60 mph (95 km/h). However, the storm maintained its sheared shape, with the precipitation associated with the tropical storm displaced well to the east of the storm centre. For this reason, the Northern Leeward Islands were not yet affected by Fiona's precipitation.

On 17 September at 0900 UTC, Fiona's centre was located approximately 75mi (121km) SW of Montserrat (16.4°N, 63.3°W), over the northeastern Caribbean Sea (Figure 1). The system maintained its westward movement, with unchanged forward velocity, unvaried estimated intensity and sheared shape (Figure 2). Starting at this time, the radar imagery showed the precipitation associated with Tropical Storm Fiona spreading over Antigua and Barbuda (Figure 3a). The precipitation was moderate to intense and lasted until 1800UTC (Figure 3b and 3c).

During the next day, Fiona crossed the northeastern Caribbean Sea moving towards Puerto Rico, and it became a hurricane on 18 September at 1500UTC, when its centre was located 50 mi (80km) S of Puerto Rico.

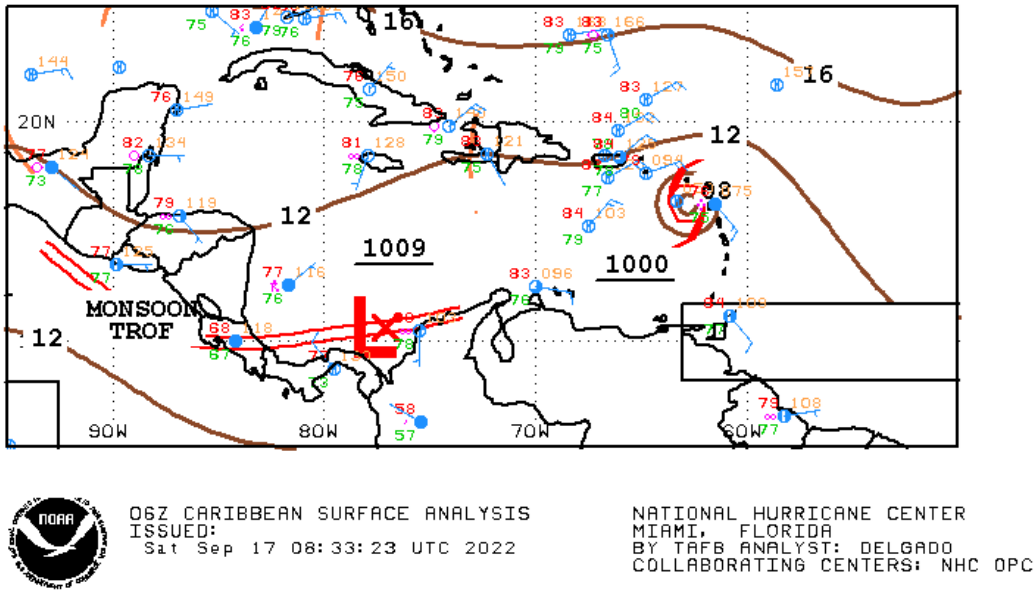


Figure 1 Surface analysis over the Caribbean area on 17 September at 0600UTC. Tropical Cyclone Fiona was located over the Northern Leeward Islands. Source: US National Hurricane Center[1]

[1]National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review date: 17 September 2022, available at: *https://www.nhc.noaa.gov/tafb/CAR_06Z.gif*

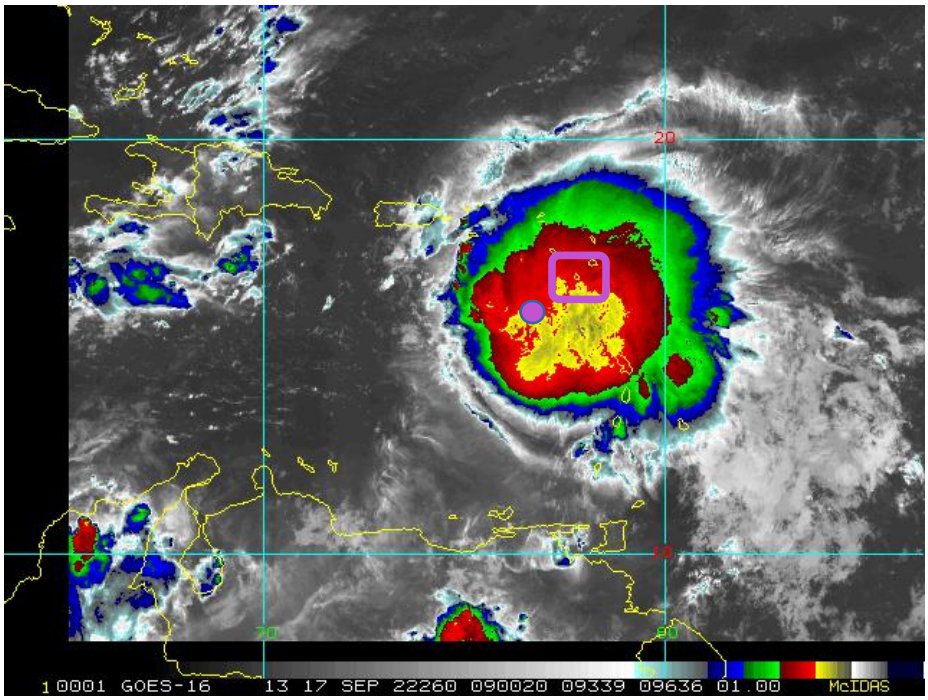
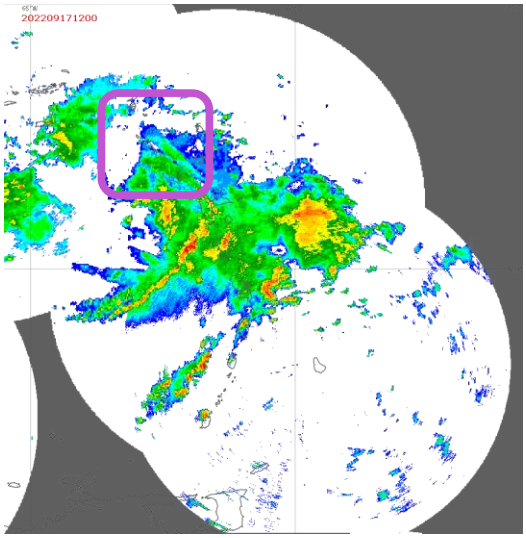
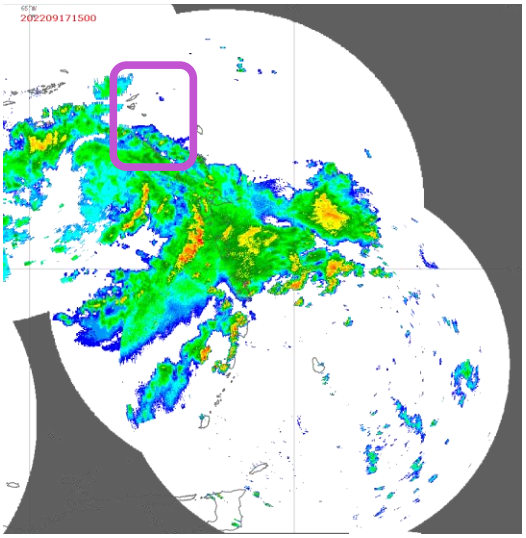


Figure 2 Satellite imagery on 17 September at 090UTC from thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C and -70°C), while the red/yellow colours represent very high altitude clouds (top cloud lower than -70°C). High altitude clouds indicate strong convection associated with intense precipitation. The circulation centre is indicated by the violet point, while the Northern Leeward Islands are surrounded by a violet square. Source: NOAA, National Environmental Satellite, Data and Information Service2.

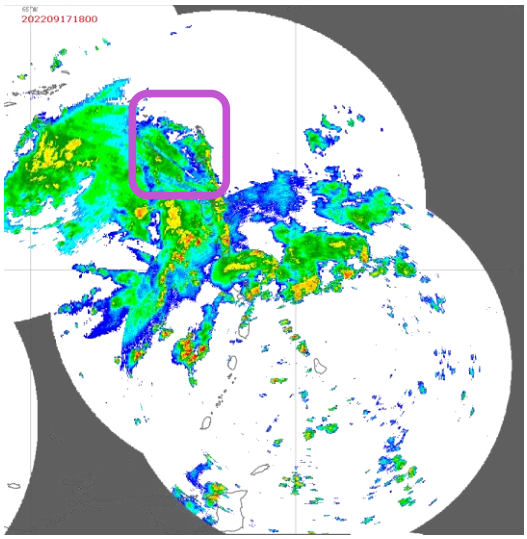


a) 17 September at 1200 UTC



b) 17 September at 1500 UTC

[2]RAMSDIS Online Archive, NOAA Satellite and Information Service, available at: https://rammb-data.cira.colostate.edu/tc_realtime/storm.asp?storm_identifier=al072022



c) 17 September at 1800 UTC

Figure 3 Radar imagery on 17 September at 1200 UTC (a) at 1500 UTC (b) and at 1800 UTC (c) as indicated in the label 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. The violet square highlights the location of Antigua and Barbuda. Source: Barbados Radar Composite[3].

3 IMPACTS

At the time of writing this event brief, no information was available related to damage or loss in Antigua and Barbuda due to this Covered Area Rainfall Event (CARE). The National Office of Disaster Services (NODS) advised residents to have necessary supplies in place, NODS was continuing to be in constant communication to keep track of the storm and inform residents about it.

4 RAINFALL MODEL OUTPUTS

All three data sources used by the XSR 2.5 model, CMORPH[4], WRF5 and WRF7[5], detected the occurrence of precipitation over Antigua and Barbuda and the surrounding waters during

[3] Barbados Radar Composite, available on 17 September at: https://www.barbadosweather.org/BMS_Radar_Composite_Resp.php#

[4] 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.

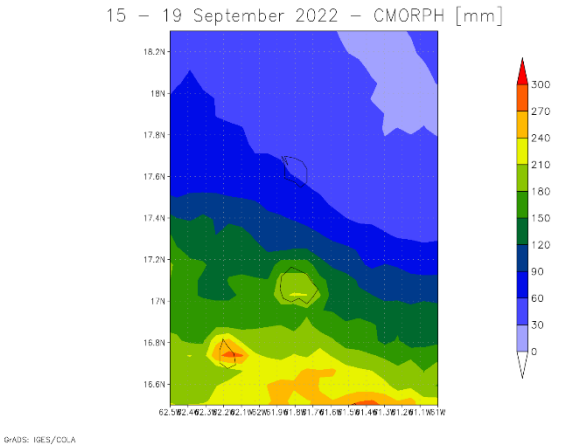
[5] WRF5 and WRF7 Models: the Weather Research and Forecasting Model weather model-based Configuration #1 and #2 data https://www.mmm.ucar.edu/weather-research-and-forecasting-model. These data are initialised by the NCEP FNL dataset. (NCEP FNL Operational Model Global Tropospheric Analyses [http://rda.ucar.edu/datasets/ds083.2/]). Further details in the Definitions section of this report.

the period 15 -19 September 2022. However, each data source reported a specific distribution and accumulation of rainfall, as discussed below. The CARE for Antigua and Barbuda was activated on 17 September and lasted for the period 17 -19 September. The CARE was activated due to the use of the 12-hour and the 48-hour aggregation intervals for precipitation[6], thus the period considered by the XSR 2.5 model for the loss estimate based on the accumulated precipitation in Antigua and Barbuda was 15-19 September.

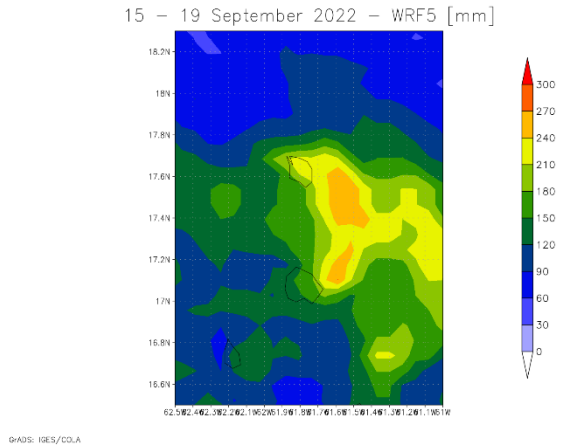
CMORPH reported total accumulated amounts of precipitation higher than 150 mm in Antigua, with a maximum between 180 mm and 210 mm in Saint Paul parish, in the south of Antigua. Precipitation values were lower in Barbuda, ranging between 30 mm and 90 mm.

WRF5 showed total accumulated values of precipitation ranging between 120 mm and 180 mm in Antigua, while higher amounts, between 180 mm and 240 mm, were reported in Barbuda.

WRF7 simulated total accumulated values of rainfall between 90 mm and 120 mm in Antigua, while lower amounts, ranging between 60 mm and 90 mm, are shown inBarbuda.

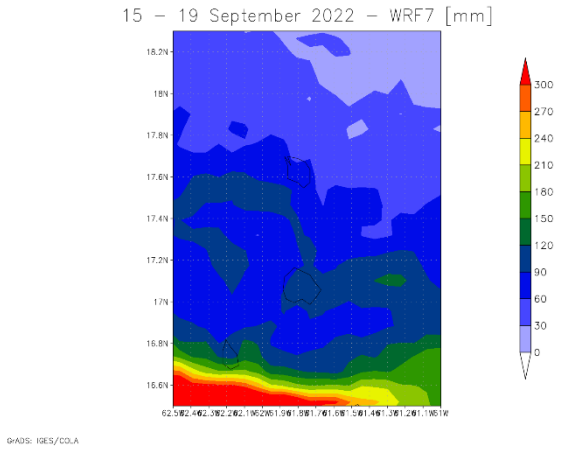


a) CMORPH



b) WRF5

[6] 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.



c) WRF7

Figure 5 Total accumulated precipitation during the period 15-19 September, 2022 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/ATG/CARE_1_2022/daily_prec_short.mp4
https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/ATG/CARE_1_2022/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Antigua and Barbuda for all three data sources used by XSR2.5, with a similar RIL produced by all three data sources. The final RIL (RIL_{FINAL}) was calculated as the average of the RILs from CMORPH, WRF5 and WRF7. The RIL_{FINAL} was greater than the attachment point of Antigua and Barbuda's excess rainfall policy and therefore it triggered a policy payout. A payment of US$420,645.00 is due under Antigua and Barbuda's excess rainfall policy.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event for Antigua and Barbuda was above the attachment point of the Excess Rainfall policy and a payout of US$420,645.00 is due.

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.