CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

Covered Area Rainfall Event (17/08/2021 to 19/08/2021)

Excess Rainfall

Event Briefing

Jamaica

27 August 2021

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1 INTRODUCTION

Jamaica was affected by Tropical Cyclone Grace, which caused adverse weather conditions that occurred between 17 August and 18 August, 2021. During this period, Jamaica was affected by heavy rainfall.

This event briefing describes the impact of rainfall on Jamaica, which was associated with a Covered Area Rainfall Event (CARE), starting on 17 August and ending on 19 August 2021. The Rainfall Index Loss (RIL) was below the attachment point of the excess rainfall policy for Jamaica and therefore no payout is due.

As reported in a separate tropical cyclone event briefing, "TC Grace: Jamaica and the Cayman Islands" dated 20 August 2021, Jamaica experienced heavy rains and strong winds from the system. The preliminary runs of the CCRIF loss model for tropical cyclones produced losses for Jamaica. However, Jamaica's tropical cyclone policy, which provides coverage for wind and storm surge, was not triggered because the modelled losses were below the policy's attachment point.

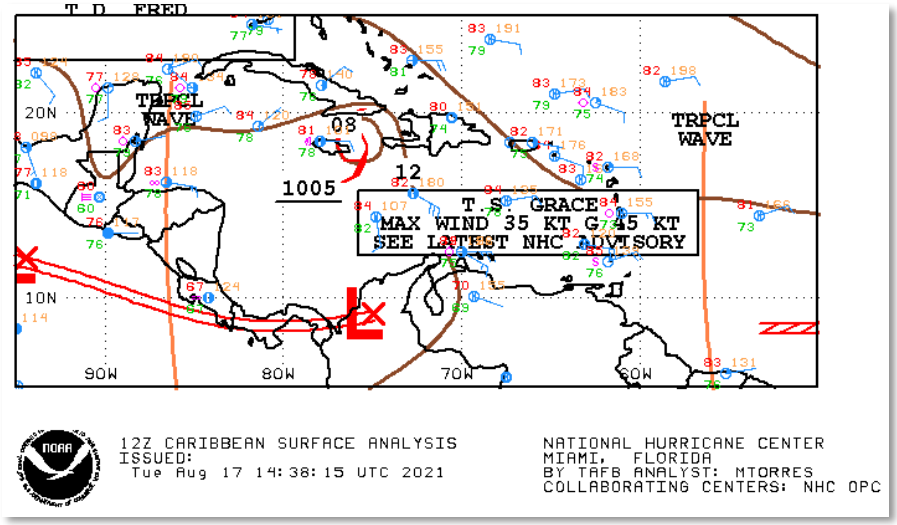
Other Tropical Cyclone event briefing reports on TC Grace's impacts have been issued for CCRIF member countries: Montserrat, St. Kitts and Nevis and Haiti. Additionally, a separate reports have been or will be issued regarding other CCRIF member countries that have excess rainfall policies.

2 EVENT DESCRIPTION

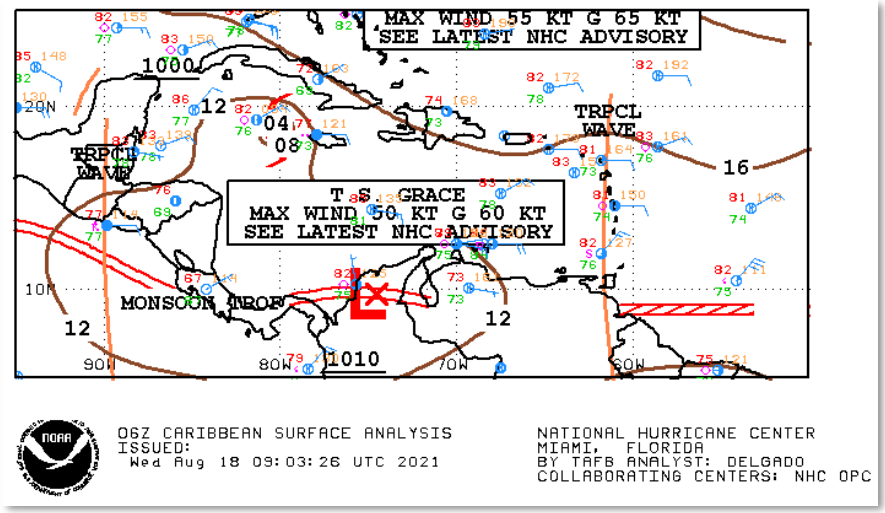
On 14 August the US National Hurricane Center (NHC) reported that a tropical storm developed over the western tropical Atlantic. It was characterized as a small tropical storm and named Grace. Over the following several hours Tropical Storm Grace became stronger as it moved westward toward the Leeward Islands and it produced stormy weather with heavy rainfall which spread across the Lesser Antilles. During the next 2 days Grace showed instability, changing its strength and character from a tropical storm to a tropical depression.

On 17 August at 0600 UTC, Grace developed into a tropical storm while it approached Jamaica (Figure 1a). At 1200 UTC the heavy precipitation associated with the western rainbands of Grace spread over the eastern portion of Jamaica. At 1500 UTC the centre of Tropical Storm Grace was located near latitude 18.3 North, longitude 76.8 West (Figure 2a) and it continued its movement toward the west with the velocity near 15 mph (24 km/h). Maximum sustained winds were near 50 mph (85 km/h) and the estimated minimum central pressure was 1005 mb. These conditions remained almost unchanged during the next 6 hours, which resulted in a continuation of heavy rains over Jamaica, particularly over the central section of the country. At 2100 UTC, the centre of the storm was located at latitude 18.4 North, longitude 77.9 West, near the northwest coast of Jamaica, about 10 km south of Montego Bay (Figure 2b). The minimum central pressure decreased to 1003 mb, and the associated heavy rainfall gradually moved over the western part of Jamaica.

On 18 August, the storm was constantly strengthening, with the maximum sustained winds increasing to near 65 mph (100 km/h) and the minimum central pressure decreasing to 993 mb. The system moved toward the west-northwest with a velocity near 16 mph (26 km/h) (Figure 1b). The intense precipitation associated with the outer rainband of Tropical Storm Grace was active over western Jamaica until 0600 UTC. Constant intensification of the system led to development of Hurricane Grace at 1500 UTC, while the system moved to the west toward the Cayman Islands. Some residual instability was present over Jamaica during the remainder of that day and the next day, 19 August, resulting in scattered showers.



a)

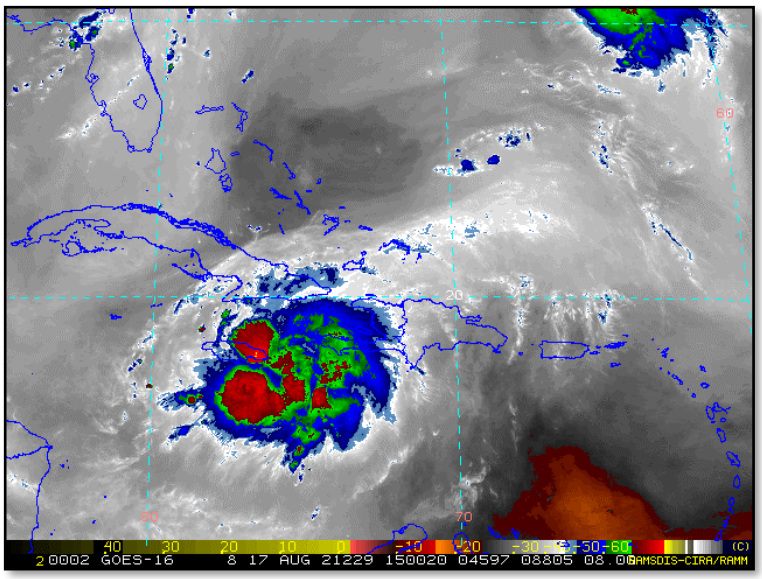


b)

Figure 1 Surface analysis over the Caribbean area on 17 (a) and 18 August (b) at the different times as indicated by the labels. Source: US National Hurricane Center[1]

[1] National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, available at:
https://www.nhc.noaa.gov/tafb/CAR_12Z.gif
https://www.nhc.noaa.gov/tafb/CAR_06Z.gif

a)



b)

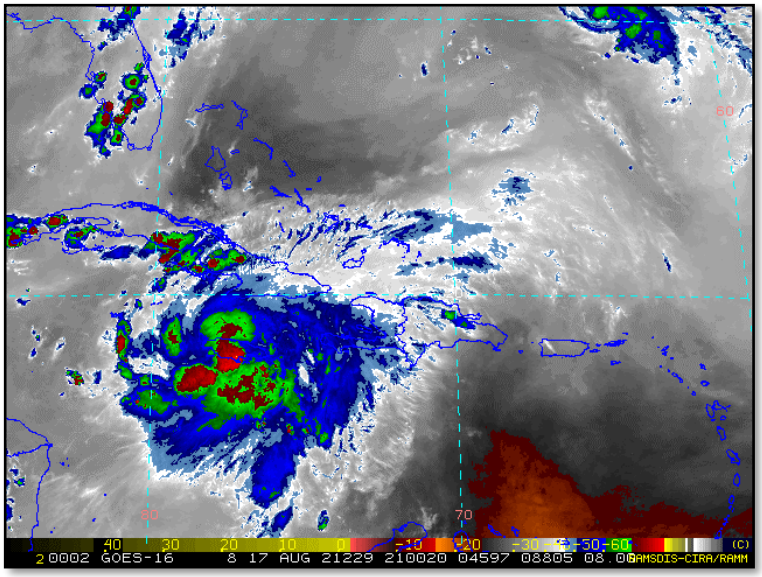


Figure 2 Satellite imagery on 17 August at 1500 UTC (a) and on 17 August at 2100 UTC (b) as indicated in the label from thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C and -70°C), while the red/yellow colours represent 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/rmtcsasec4ir304/rmtcsasec4ir304_20210817150020.gif
https://rammb.cira.colostate.edu/ramsdis/online/images/rmtc/rmtcsasec4ir304/rmtcsasec4ir304_20210817210020.gif

3 IMPACTS

The Caribbean Disaster Emergency Management Agency[3] (CDEMA), reported that Tropical Storm Grace caused flooding, fallen trees, landslides, and blocked roads. Figure 3 shows the affected parishes.

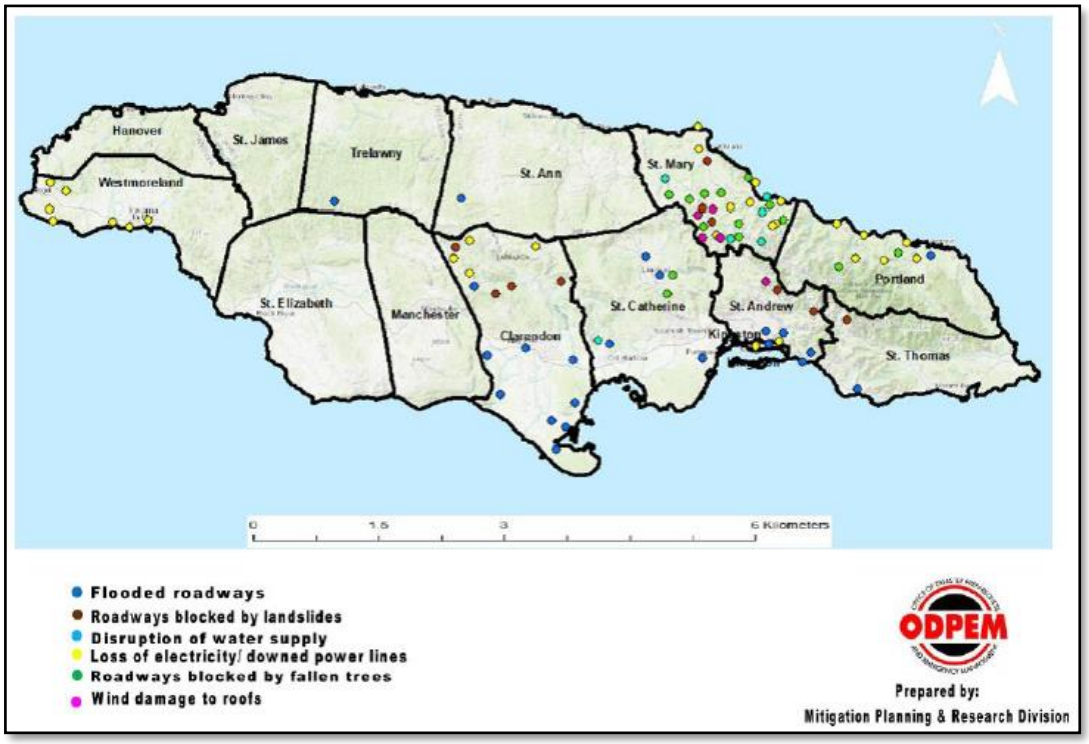


Figure 3 Map showing the affected Parishes associated with Tropical Cyclone Grace in Jamaica. Source: CDEMA

Prime Minister of Jamaica, Hon. Andrew M. Holness, reported that the parishes with the greatest damage were Kingston, St. Andrew, St. Thomas, Portland, St. Mary, and Clarendon. About 200 roads were affected. There was no reported loss of life due to Tropical Storm Grace[4].

As of the date of this report, the following information had been published in the local news[5]:

- Due to fallen poles and trees, roads were blocked
- Homes were flooded and vehicles disabled
- In St. Mary and Portland powerful winds damaged croplands
- The roof of the Annotto Bay Fire Station in St. Mary was partially damaged

[3] CDEMA - Caribbean Disaster Emergency Management Agency, Situation Report No. 2 (As of 4:00 PM on August 19, 2021), review date: 19 August 2021, available at: '*Tropical Storm Grace*'

[4] Jamaica Observer, review date: 20 August 2021, available at: '*Damage from Grace put at $171m*'

[5] The Gleaner Company, review date: 20 August 2021, available at: '*Grace but no mercy: Storm drenches eastern Jamaica*'

- The Bull Bay main road in St. Andrew and Marcus Garvey Drive in Kingston were impassable
- Several communities in St. Mary were flooded
- There were landslides and floods in east and west rural St. Andrew
- The power network in Kingston, St. Andrew, St. Catherine, St. Thomas, St. Mary, and St. Ann was damaged.

Prior to the arrival of the storm, a Tropical Storm Warning was put into effect. Jamaica's authorities took precautionary measures such as opening some emergency shelters and air traffic was temporarily suspended.

Figure 4 shows some of rainfall damage caused by Tropical Storm Grace in Jamaica.

Figure 4 Some of rainfall damage caused by Tropical Storm Grace in Jamaica – August, 2021.
Source: The Gleaner Company

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 Jamaica and the surrounding waters during the period 15 – 19 August 2021. However, each data source reported a specific distribution and accumulation of rainfall, as discussed below. The CARE for Jamaica was activated on 17 August and lasted for the period 17 – 19 August. The CARE was activated due to the use of the 12-hour and the 48-hour

[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.

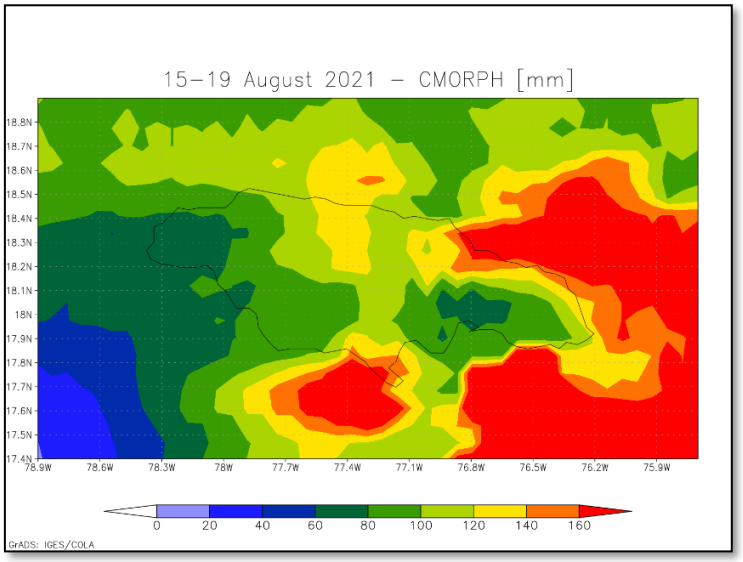
[7] WRF5 and WRF7 Models: the Weather Research and Forecasting Model weather model-based Configuration #1 and #2 data *https://www.mmm.ucar.edu/weather-research-and-forecasting-model*. These data are initialised by the NCEP FNL dataset. (NCEP FNL Operational Model Global Tropospheric Analyses [*http://rda.ucar.edu/datasets/ds083.2/*]).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

aggregation intervals for precipitation[8], thus the period considered by the XSR2.5 model for the loss estimate based on the accumulated precipitation in Jamaica was 15 – 19 August.

CMORPH reported total accumulated amounts of precipitation between 100 mm and 160 mm over the central and northern areas of Jamaica. In the west and southeast of the country, precipitation values were lower, ranging between 60 mm and 100 mm.

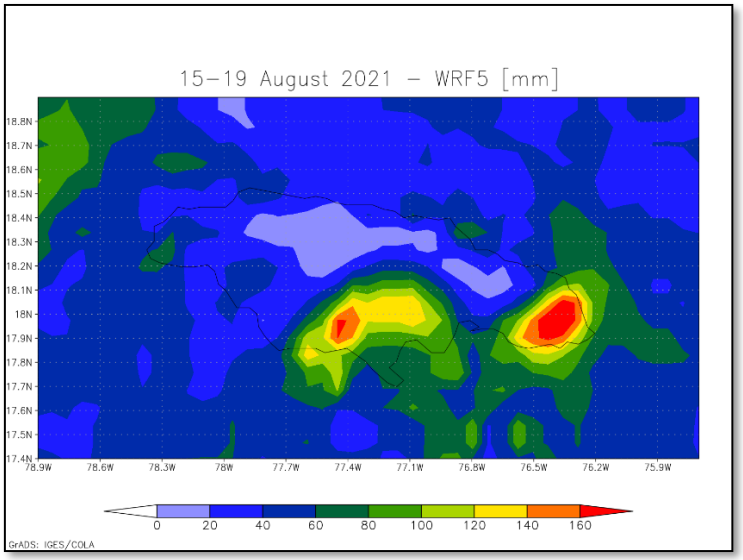
WRF5 showed total accumulated values of precipitation between 20 mm and 40 mm over most of Jamaica, while higher values, between 80 mm and 160 mm, were reported over the south central area and the eastern area.

WRF7 simulated total accumulated values of rainfall with a similar pattern to that of WRF5. The highest values of precipitation were presented in the central southern area, where the values were in the range between 60 mm and 140 mm. For the rest of the country, the simulated precipitation values varied between 20 mm and 80 mm in the northern part of the country and between 60 mm and 140 mm in the eastern part.

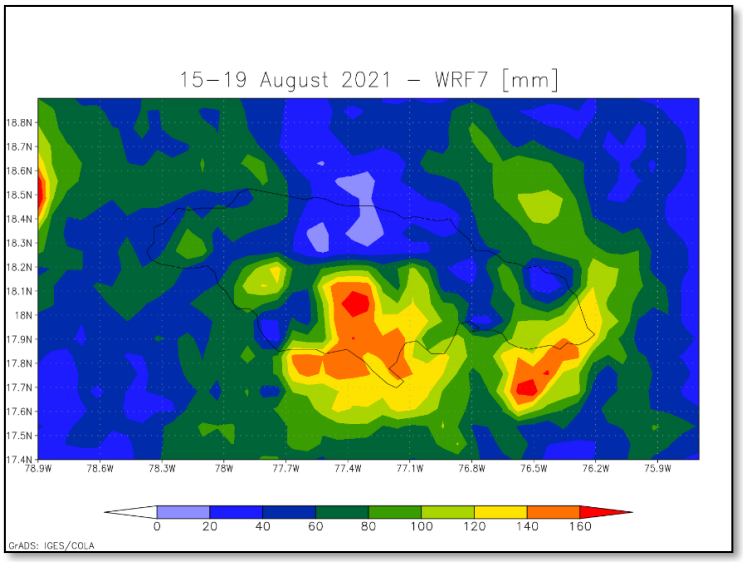


a) CMORPH

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.



b) WRF5



c) WRF7

Figure 5 Total accumulated precipitation during the period 15 August – 19 August, 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/JAM/CARE_2_2021/daily_prec_short.mp4
https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/JAM/CARE_2_2021/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Jamaica for all three data sources used by XSR2.5: CMORPH, WRF5 and WRF7. The RIL was the highest for WRF7, due to the

larger amount of accumulated precipitation presented along the south coast in the vicinity of the capital, Kingston, the area characterized by the highest exposure for Jamaica.

The final RIL (RIL_{FINAL}) was calculated as the average of the RILs from the three data sources. 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 Jamaica's excess rainfall policy and therefore it did not trigger a policy payment.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event was below the attachment point of Jamaica's excess rainfall policy and therefore no payout 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.