CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

9/11/2024 to 11/11/2024

Excess Rainfall
Wind and Storm Surge

Final Event Briefing

National Water and Sewerage Authority, Grenada

19 November 2024

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1 SUMMARY

Between 8 and 9 November 2024, a tropical wave crossed the Lesser Antilles, moving into the eastern Caribbean Sea. A large cluster of thunderstorms was behind the wave and affected portions of the Lesser Antilles with heavy precipitation, in particular Grenada from the late hours of 8 November to the early hours of 9 November. During the next 2 days, residual instability fuelled scattered showers of moderate intensity over the region, prolonging the rainfall event over Grenada.

The runs of the CCRIF CWUIC model[1] have produced losses for the National Water and Sewerage Authority (NAWASA) in Grenada. The losses for NAWASA are below the Attachment Point of its CWUIC policy and therefore no payout under this policy is due.

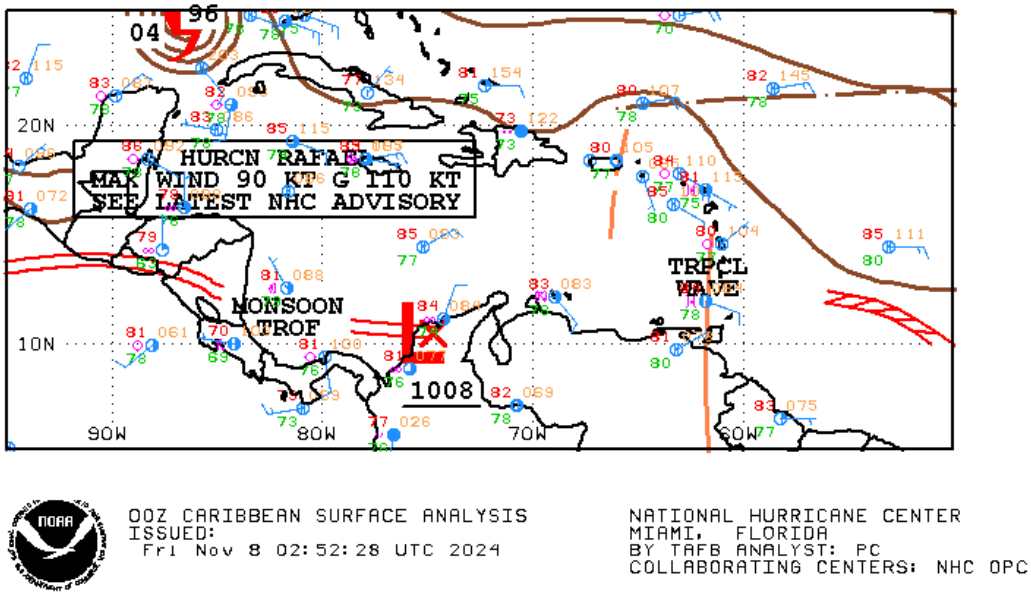
This event briefing is designed to review the modelled losses due to wind, storm surge and excess rainfall calculated by CCRIF's CWUIC model for affected CCRIF member water utilities, to be analyzed with respect to members' CWUIC policies. NAWASA was the only CCRIF water utility member for which the CCRIF CWUIC loss model for wind, storm surge and excess rainfall produced losses due to this rainfall event.

2 INTRODUCTION

On 8 November, a tropical wave was over the eastern Caribbean Sea with axis along longitude 62°- 63°West, just west of the Lesser Antilles, moving west at 11-17 mph (18-28 km/h), Figure 1. A large cluster of moderate to strong convection was behind the wave axis from latitude 11°North to 15°North, between longitude 57°West and 61°West, affecting parts of the Lesser Antilles, including Grenada, starting from the late hours of 8 November. During the following hours, the convection activity in the region intensified and peaked in the early hours of 9 November, between 0000UTC and 0600UTC. The satellite imagery in Figure 2a and 2b revealed that during this period an intense thunderstorm was active over Grenada and nearby waters, affecting the area with heavy rainfall.

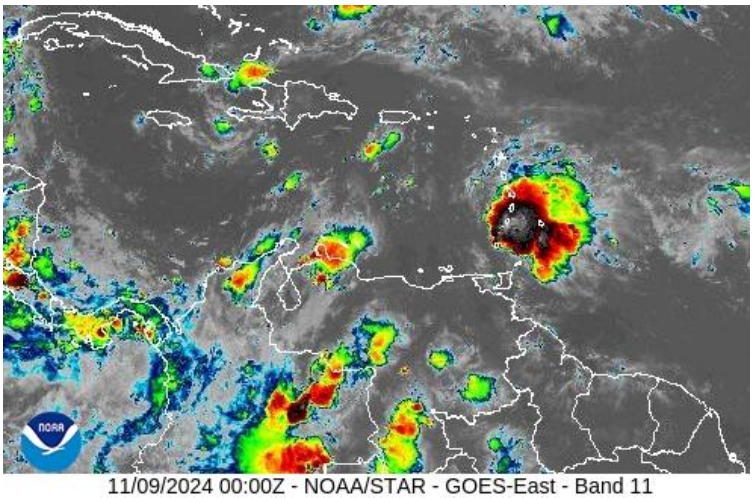
Late on 9 November, as the tropical wave moved westward, the cluster of thunderstorms moved away from the Lesser Antilles. However, lingering atmospheric moisture and residual instability continued to produce intermittent showers over the country, from the late hours of 9 November until the evening of 10 November (Figure 2c). On 11 November, the influence of the tropical wave gradually ceased, with showers becoming less frequent throughout the day over the eastern Caribbean Sea.

[1] Caribbean Water Utilities Insurance Collective



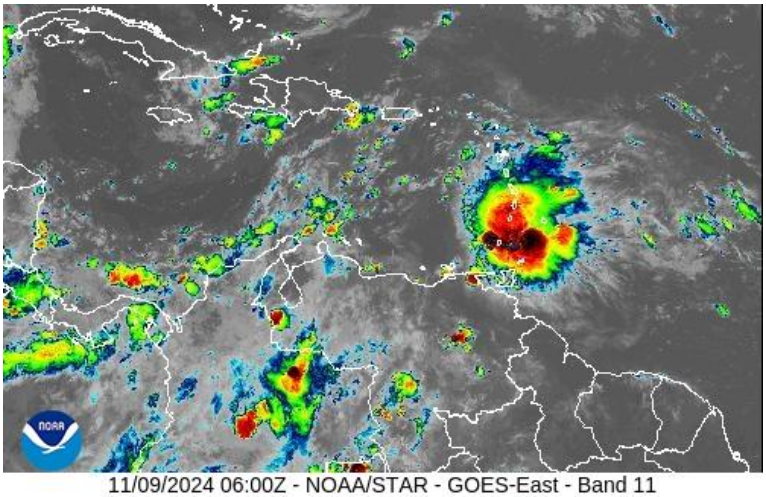
8 November at 0000 UTC

Figure 1. Surface analysis over the Caribbean Sea area on 8 November 2024 at 0000 UTC. Source: US National Hurricane Center[2]

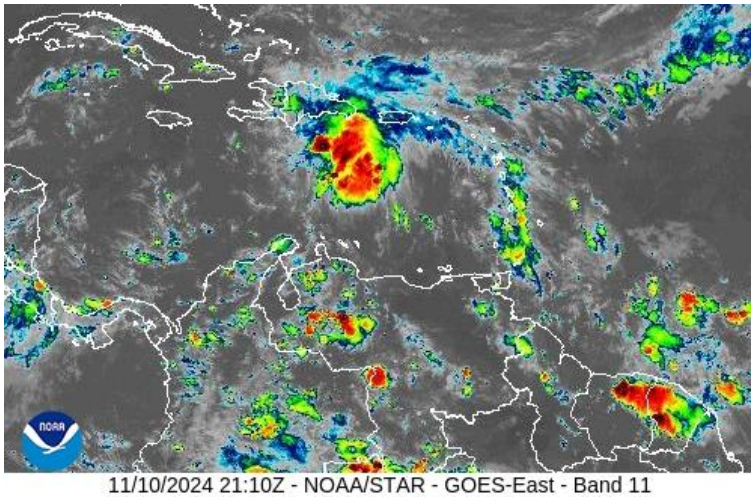


a) 9 November at 0000 UTC

[2] National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review dates: 8 November 2024, available at: https://www.nhc.noaa.gov/tafb/CAR_00Z.gif



b) 9 November at 0600 UTC



c) 10 November at 2120 UTC

Figure 2. Satellite imagery from (a) 9 November 2024 at 0000 UTC, (b) 9 November 2024 at 0600 UTC, and c) 10 November 2024 at 2110 UTC. 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[3]

3 CCRIF SPC MODEL OUTPUTS

The CWUIC model is made up of two components: the tropical cyclone (TC) component, accounting for the losses produced by wind and storm surge, and the excess rainfall (XSR)

[3] RAMSDIS Online Archive, NOAA Satellite and Information Service, available at: https://cdn.star.nesdis.noaa.gov/GOES16/ABI/SECTOR/car/11/

component, accounting for the losses associated with excess rainfall. Each of the two model components estimates a loss value specifically related to the hazard for which it is designed. When both a tropical cyclone and a Covered Area Rainfall Event (CARE) happen at the same time, the outputs of the two model components are added together. When only one model component, TC or XSR, reports losses associated with a specific event, only the losses produced for that component are counted. In the following description, the model output for each component is described separately.

TC Component

There is no tropical cyclone component related to this CARE. No tropical cyclone occurs during this CARE (9 - 11 November 2024). Thus, the are no CWUIC TC losses.

XSR Component

All data sources used by the XSR 3.0 model, CMORPH, IMERG, WRF5, WRF7, WRF11 and WRF15[4], detected the occurrence of precipitation over Grenada and the surrounding waters during the period 7 to 11 November 2024. Each data source reported a specific distribution and accumulation of rainfall, as discussed below and shown in Figure 5. A CARE for Grenada was activated on 9 November and lasted until 11 November. The CARE was activated due to the use of the 12-hour and the 48-hour aggregation intervals for precipitation[5] and thus the period considered by the XSR 3.0 model for the loss estimate based on the accumulated precipitation in the Grenada was 07 to 11 November 2024.

CMORPH	CMORPH reported total accumulated values of precipitation higher than 80 mm over all of Grenada, increasing from north to south. The maximum values, between 120 mm and 140 mm, were reported over the southern edge of Grenada.
IMERG	IMERG reported total accumulated values of precipitation higher than 80 mm over all of Grenada, with the maximum values, between 120 mm and 160 mm, over central and southern Grenada and over Carriacou. A local maximum, between 160 mm and 180 mm occurred over Petite Martinique.

[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 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.

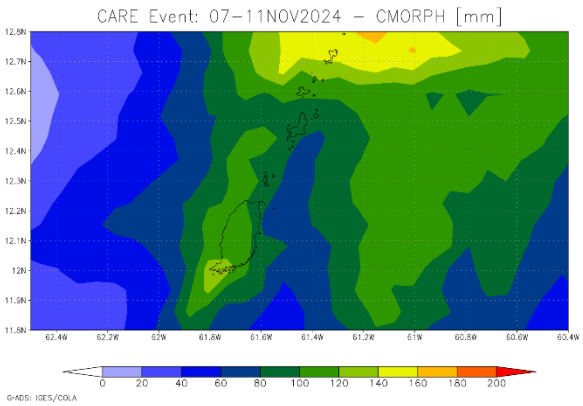
[5] The two aggregation periods correspond to the Rainfall Aggregation Period #1 and Rainfall Aggregation Period #2, as indicated in the Schedule. Further details in the Definitions section of this report.

WRF5 WRF5 showed total accumulated values of precipitation higher than 80 mm over most of Grenada, with the highest values, between 160 mm and 180 mm, along the southeast coast, in the parish of St. Davis.

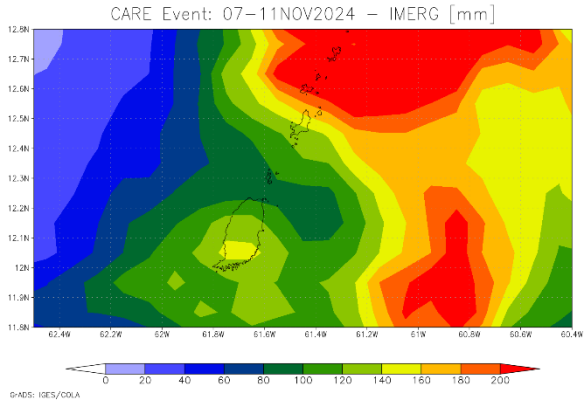
WRF7 WRF7 showed total accumulated values of precipitation higher than 80 mm only along the southeast coast, in the parish of St. Davis, while lower values were reported over the rest of the country.

WRF11 WRF11 reported accumulated values of precipitation lower than 60 mm over all of Grenada.

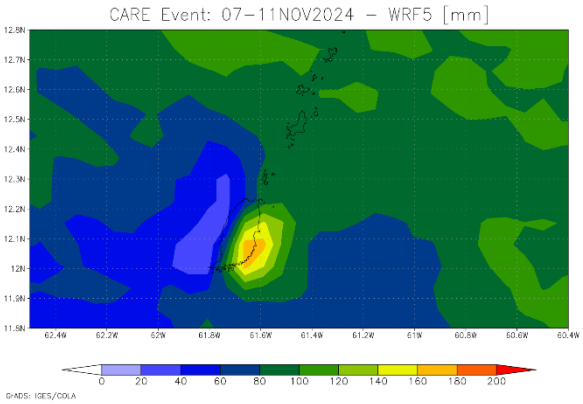
WRF15 WRF15 reported accumulated values of precipitation than 60 mm over all of Grenada.



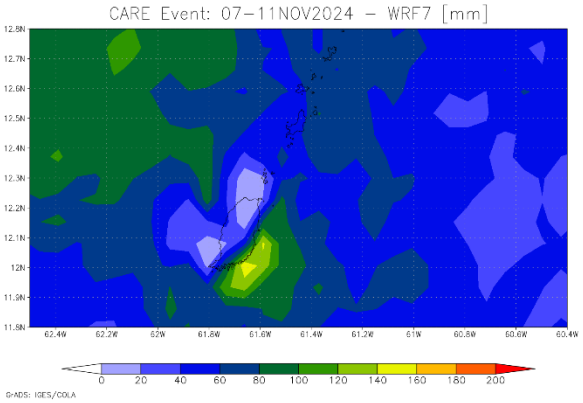
a) CMORPH



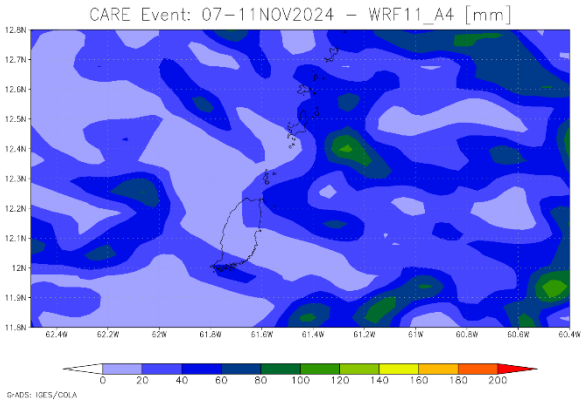
b) IMERG



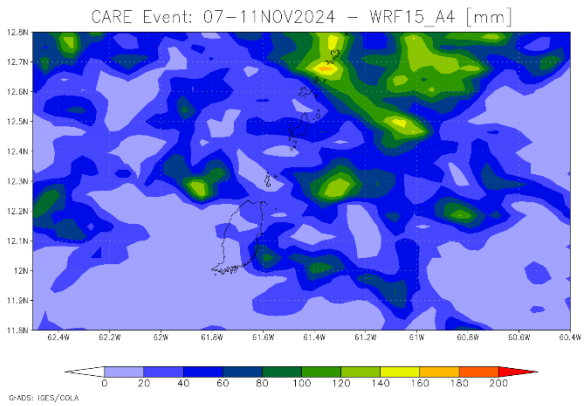
c) WRF5



d) WRF7



e) WRF11



f) WRF15

Figure 5 Total accumulated precipitation during the period 07 and 11 November, 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_3_2024/daily_prec_short.mp4

https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/GRD/CARE_3_2024/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Grenada for four of the data sources used by XSR3.0: CMORPH, IMERG, WRF5 and WRF7. The RIL was the highest for IMERG. No Disaster Alert declaration was issued by ReliefWeb for Grenada related to the rainfall events during this period.

4 REPORTED IMPACTS

On November 9 NAWASA reported impacts on water systems due to dam blockages and high turbidity due to the heavy rainfall [6] and a damaged pipeline in Content, St. David, caused by a landslide. [7]

[6] NAWASA Grenada Facebook page: Facebook
[7] NAWASA Grenada Facebook page: Facebook

Figure 6. Damaged pipeline in St. David

By November 10, NAWASA began restoring water supply to affected communities in St. Andrew, Mirabeau, Mt. Horne, St. John, Concord, Mt. Plaisir, St. George, St. Patrick, Peggy´s Whim, Mt. Reuli, St. David, and Mt. Agnes.[8]

5 CCRIF LOSS MODEL

The final run of the CCRIF´s CWUIC tropical cyclone and excess rainfall loss model for the National Water and Sewerage Authority (NAWASA) in Grenada, produced losses below the Attachment Point of its CWUIC policy and therefore no payout under this policy is due.

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

[8] NAWASA Grenada Facebook page: Facebook

DEFINITIONS

Active Exposure Cell Percentage Threshold	The percentage of the total number of XSR Exposure Grid Cellswithin 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 daythe 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 AggregationPeriod#1 of n hours, the Aggregate Rainfall #1 is the maximumamount of rainfall accumulated over any of the n-hour windowsthat 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 AggregationPeriod#2 of n hours, the Aggregate Rainfall #2 is the maximumamount of rainfall accumulated over any of the n-hour windowsthat intersect the day itself considering a time interval of 3 hours.
Calculation Agent	Entity charged with undertaking the primary calculation ofthe 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 continuousbasis by the XSR Model Data Reporting Agency used bythe 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. Measurementunits and precision of data ingested by the XSR Rainfall Modelare 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 Relief Web (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 Relief Web 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.