Covered Area Rainfall Event (03/11/2022)

Excess Rainfall

Event Briefing

Belize

9 November 2022

1   INTRODUCTION

This event briefing describes the impact of rainfall in Belize, which was associated with a Covered Area Rainfall Event (CARE), on 3 November 2022. The Rainfall Index Loss (RIL) was below the attachment point of Belize's excess rainfall policy and therefore no payout is due.

2   EVENT DESCRIPTION

On 31 October at 1500UTC, the US National Hurricane Center (NHC) indicated that a tropical storm formed over the central Caribbean Sea, and it was named Lisa. Its centre was approximately sited near latitude 15.5° North, longitude 77.3° West, about 175 mi (285 km) S of Jamaica. The system proceeded with estimated forward velocity of 14 mph (22 km/h) towards the west, as it moved along the southern side of a high pressure area located over the southern United States of America. The minimum central pressure was 1003 mb and the maximum sustained winds were estimated at 40 mph (65 km/h).

During the next 24 hours, the tropical storm continued to move west-northwestward over the very warm waters of the western Caribbean Sea, where the oceanic heat content and the low to moderate wind shear favoured intensification of the system. However, the infiltration of dry air into the topical storm's circulation slowed down the intensification. Starting from 1 November at 1200UTC, the system steadily strengthened, due to the level of humidity in the environment. Therefore, the minimum central pressure gradually decreased and the system improved in organization and intensity, while it headed towards Belize.

On 2 November at 1200UTC, the NHC reported that Lisa became a Category 1 hurricane. At this time, the centre of Hurricane Lisa was located near latitude 17.2° North, longitude 86.7° West, about 100 mi (165 km) ESE of Belize City, the capital of Belize. The minimum central pressure was 988 mb and the maximum sustained winds were estimated at 75 mph (120 km/h), while the forward velocity was almost unchanged.

During the next few hours preceeding landfall, Lisa showed little change in intensity but improvement in organization. The satellite imagery at 1800 UTC showed that Lisa was a small hurricane, with the inner-core hurricane-force-wind area only about 15 mi (30 km) across, and a strong convection plume close to the circulation centre (Figure 1). At this time, Lisa's eye was very near to Belize coast, near latitude 17.3° North, longitude 87.7° West, about 35 mi (60 km) ESE of Belize City (Figure 2). The radar images showed the intense precipitation associated with the inner rainbands of the hurricane affecting Belize's coastal area from 1500UTC (Figure 3a), while at 1800UTC most of northern and eastern Belize was already affected by moderate to intense rainfall (Figure 3b). Approximately three hours later, at 2120 UTC, Lisa's eye made landfall on Belize, near the mouth of the Sibun River, about 10 mi (16 km) SW of Belize City. The maximum sustained winds were estimated at 85 mph (140 km/h), and the minimum central pressure was estimated at 990 mb. At this time, the most active northern inner rainbands of Lisa were spreading

moderate to heavy precipitation over northern and central Belize, while localized moderate precipitation was present over southern Belize (Figure 3c).
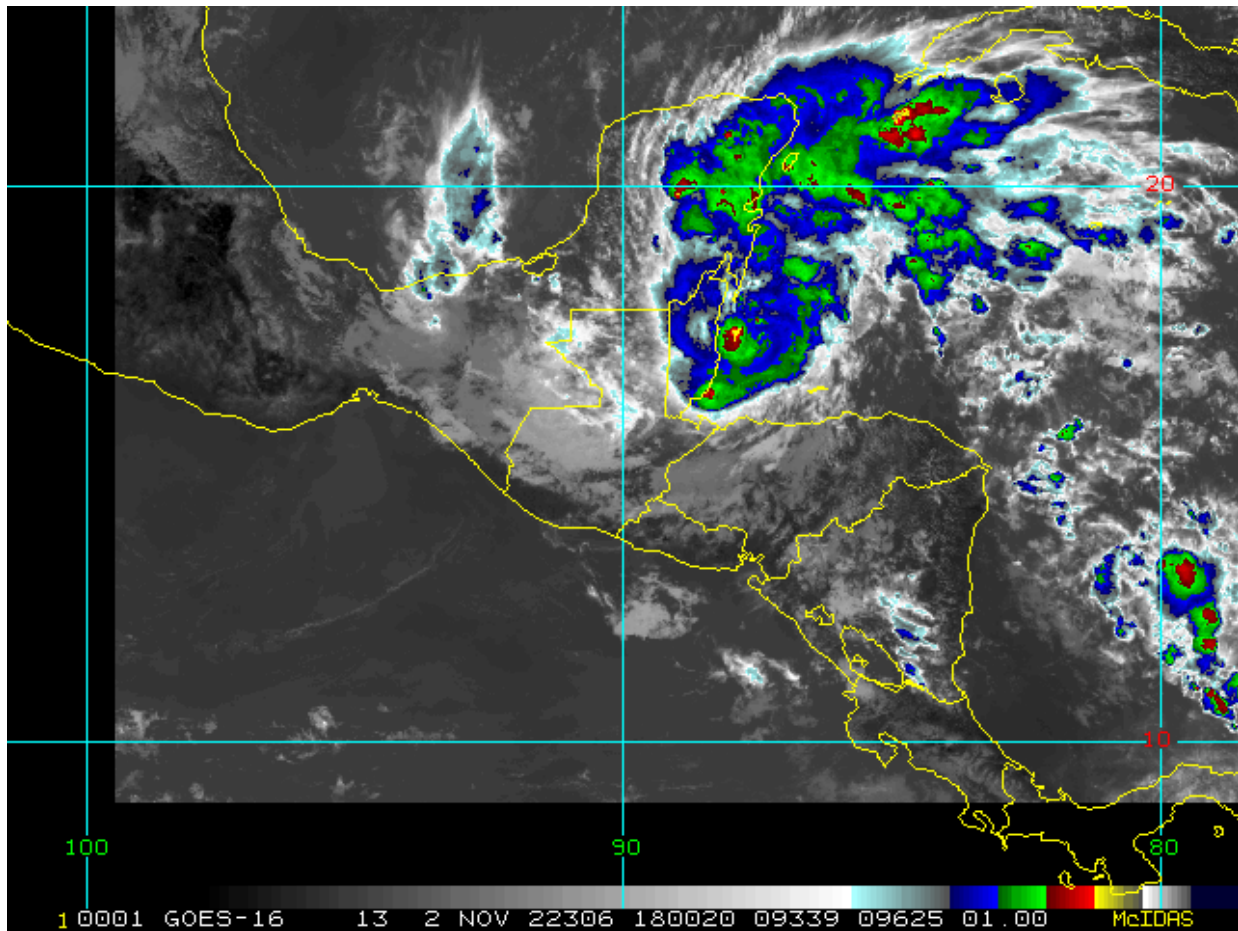

Figure 1 Satellite imagery on 2 November at 1800UTC from thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C and -70°C), while the red/yellow colours represent very high altitude clouds (top cloud lower than -70°C). High altitude clouds indicate strong convection associated with intense precipitation. Source: NOAA, National Environmental Satellite, Data and Information Service[1].
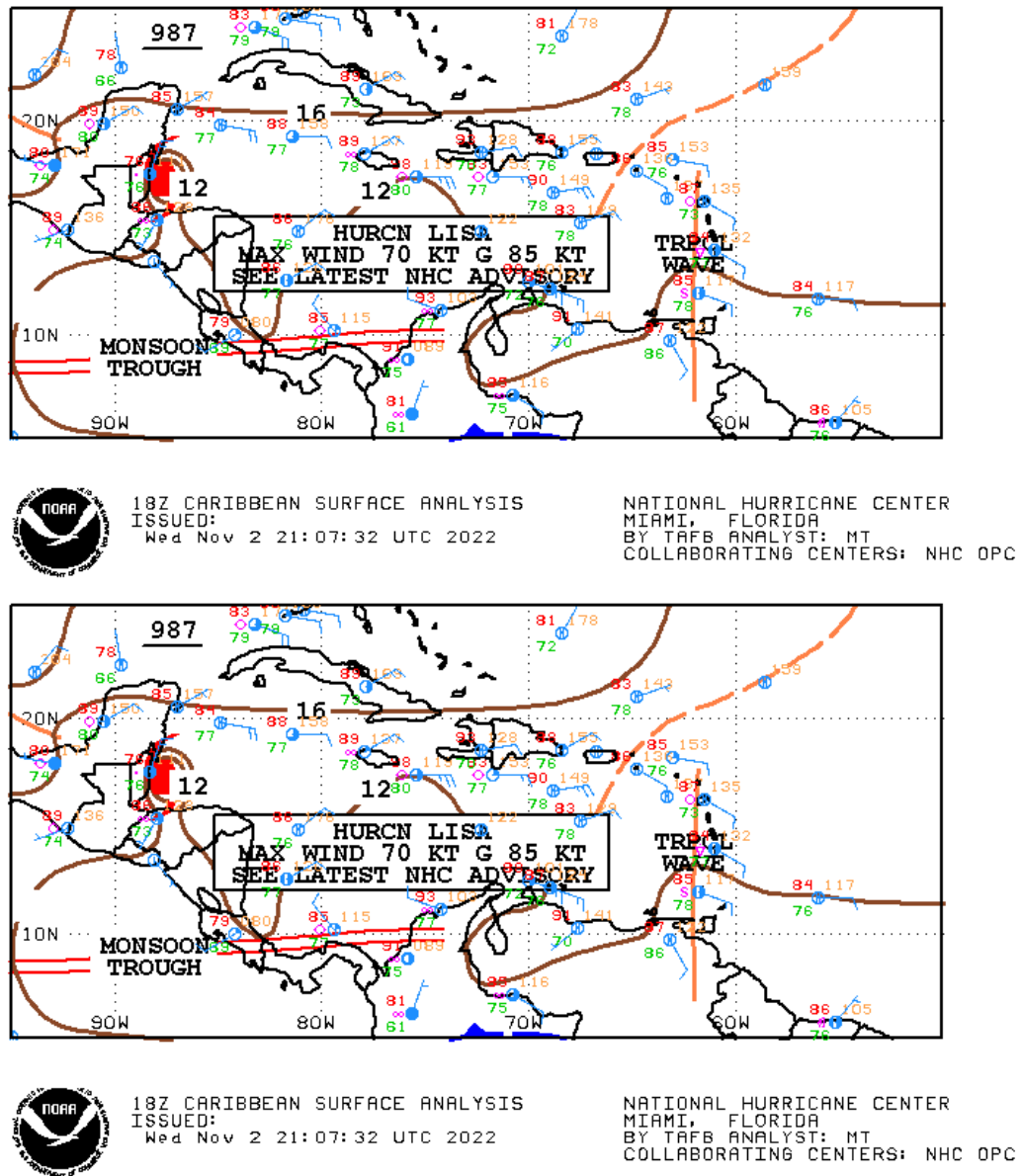

Figure 2. Surface analysis over the Caribbean area on 2 November 2022 at 1800UTC. Source: US National Hurricane Center[2]

After landfall, Lisa proceeded westward crossing Belize at about 12 mph (19 km/h), while losing intensity rapidly due to interaction with the land. Three hours after landfall, on 3 November at 0000UTC, the maximum sustained winds decreased to 75 mph (120km/h), while Lisa's centre was sited about 20 mi (30 km) ESE of Belize City. At this time, the active northern rainbands of Lisa were still affecting northern and central Belize with moderate to heavy rainfall (Figure 3d). At

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2   National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review date: 2 November 2022, available at: *https://www.nhc.noaa.gov/tafb/CAR_18Z.gif*

0300UTC, six hours after landfall, Lisa was downgraded to a tropical storm, while its centre moved away from Belize toward northern Guatemala. At that time, moderate to locally heavy rainfall was affecting only the northwestern portion of Belize (Figure 3e) and in the next three hours the tropical cyclone moved past the country.

During the next 6 hours, Lisa continued to move westward, crossing northern Guatemala and southern Mexico. Interaction with the land caused continuous weakening, with Lisa becoming a tropical depression at 1500UTC of the same day (3 November). On the next day, 4 November, Lisa emerged over the Bay of Campeche and at 0900UTC it dissipated.

a) 2 November at 1500UTC

b) 2 November at 1800UTC

c) 2 November at 2100UTC

d) 3 November at 0000UTC
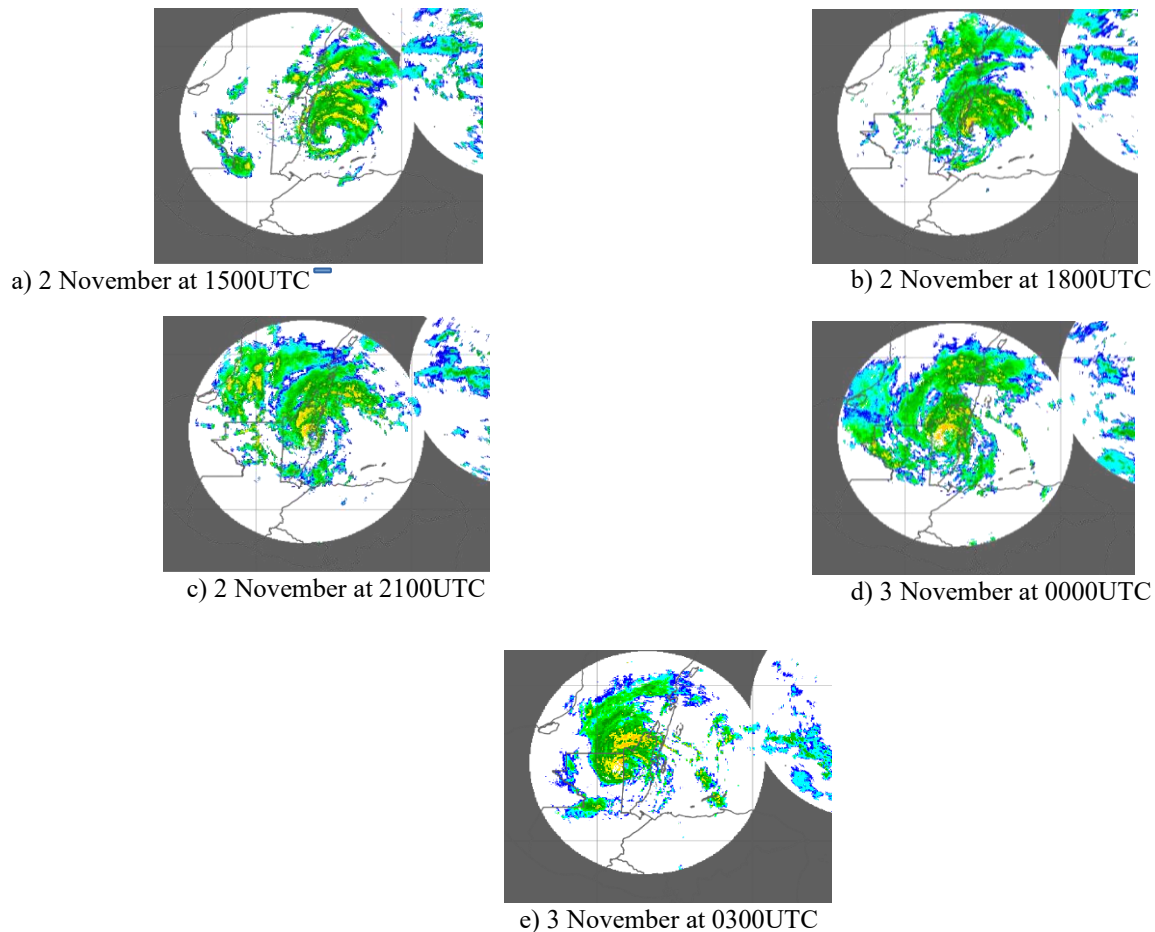
e) 3 November at 0300UTC

Figure 3 Radar imagery on 2 and 3 November 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].

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3   Barbados Radar Composite, available on 2 and 3 November at:
_https://www.barbadosweather.org/BMS_Radar_Composite_Resp.php#_

3   IMPACTS

The major damage in Belize, after the passage of Tropical Storm Lisa, according to online news agencies[4] were floods and power outages in Belize City.

a)   Flooded area

b) Utility poles fallen down

c) Fallen down trees

d) Fallen roof tops

Figure 3 Damage in Belize City

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[4] Tropical Storm Lisa causes floods in Belize City (usatoday.com)

4 RAINFALL MODEL OUTPUTS

All three data sources used by the XSR 2.5 model, CMORPH[5], WRF5 and WRF7[6], detected the occurrence of precipitation over Belize and the surrounding waters on 3 November 2022. However, each data source reported a specific distribution and accumulation of rainfall, as discussed below. The CARE for Belize was activated on 3 November and lasted for one day. The CARE was activated due to the use of the 12-hour and the 48-hour aggregation intervals for precipitation[7], thus the period considered by the XSR 2.5 model for the loss estimate based on the accumulated precipitation in Belize was from 1 to 3 November 2022.

CMORPH reported total accumulated precipitation higher than 60 mm over most of northern Belize, with maximum values between 80 mm and 100 mm over the north-eastern area, just north of Belize City, the capital of Belize. Over central Belize, the rainfall values were shown ranging between 20 mm and 60 mm, while lower values were reported over southern Belize.

WRF5 showed total accumulated values of rainfall higher than 60 mm over central and northern Belize. The maximum precipitation values, ranging between 160 mm and 180 mm, were shown in the central portion of the country, in the Cayo and Stann Creek districts. Over southern Belize, the reported values of accumulated rainfall were lower than 40 mm

WRF7 simulated total accumulated values of rainfall higher than 60 mm over central and northern Belize. Moreover, values higher than 160 mm were reported over a large area surrounding the point of landfall with a radius of about 40 km and the inland track of the hurricane, thus covering Belize district, and parts of Cayo and Orange Walk districts. The maximum rainfall values within this area ranged between 220 mm and 240 mm and they were in three clusters, located just north of Belize City, just south of Belize City and more inland in the Orange Walk district. Over most of southern Belize, the reported accumulated precipitation values were lower than 40 mm.

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5   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.

6   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.

7   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.
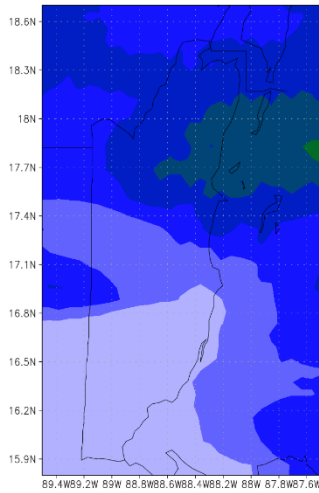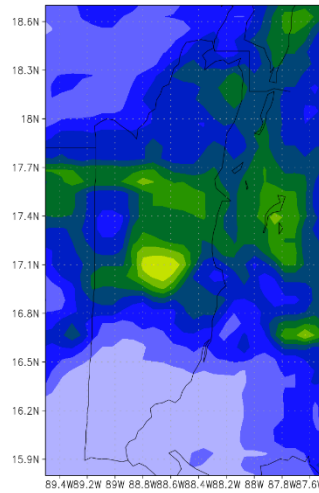
a) CMORPH

b) WRF5
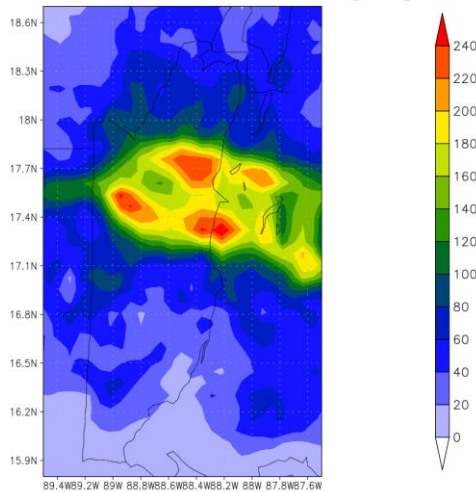
c) WRF7

Figure 5 Total accumulated precipitation during the period 1-3 November, 2022
estimated by CMORPH (a), WRF5 (b) and WRF7 (c) over Belize. 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/BLZ/CARE_4_2022/daily_prec_short.mp4
https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/BLZ/CARE_4_2022/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Belize for two of the data sources used by XSR2.5: WRF5 and WRF7. The RIL was the highest for WRF7, due to the larger value of total accumulated precipitation reported over Belize City and the surrounding region, the area characterized by the highest exposure for Belize. Additionally, a disaster alert declaration was issued from ReliefWeb related to Tropical Cyclone Lisa for Belize (https://reliefweb.int/taxonomy/term/51374).

The final RIL (RIL_{FINAL}) was calculated as the average of the RILs from WRF5 and WRF7. 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 Belize' excess rainfall policy and therefore it did not trigger a policy payout.

5   TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) for Belize was below the attachment point of the country'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.