Covered Area Rainfall Event (08/06/2023 to 13/06/2023)

Excess Rainfall

Event Briefing

The Bahamas Central

20 June 2023

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1 INTRODUCTION

The Bahamas was affected by the newly formed Tropical Depression Two, resulting in adverse weather conditions from 8 to 13 June 2023. During this period, the heaviest rainfall occurred over the central areas of the country.

This event briefing describes the impact of rainfall covered by The Bahamas' Excess Rainfall policy for the Central[1] region, which was associated with a Covered Area Rainfall Event (CARE), starting on 8 June and ending on 13 June 2023. The Rainfall Index Loss (RIL) was below the attachment point of the Excess Rainfall policy for The Bahamas - Central and therefore no payout is due.

The policy endorsements, the Localized Event Trigger[2] (LET) and Wet Season Trigger[3] (WST) were not activated.

2 EVENT DESCRIPTION

On 9 June at 0600 UTC rainfall characterized as "widely scattered moderate" to "isolated strong" occurred to the northwest of the line that ran from 31N48W to 20N70W. The greatest amount of precipitation was characterized as "scattered strong" from 22N to 24N between 74W and 76W in The Bahamas.

At 1800 UTC an upper level trough located over the eastern Gulf of Mexico with southwest flow extending down to the surface transported a large amount of moisture northward from the deep tropics, creating an atmospheric river over Cuba and the Central Bahamas.

In the 24 hours preceding 0000 UTC on 10 June, in The Bahamas, 8 inches (200 mm) of rainfall were reported on Exuma and 4 inches (100 mm) were reported on Long Island. High pressure of 1021 mb, located over the central Atlantic near 27N49W, created a ridge westward across the Greater Antilles, The Bahamas and the western Atlantic. Multilayer clouds with embedded showers and thunderstorms dominated most of the waters west of 70W. This cloudiness was associated with strong upper-level southwest winds. Moderate to fresh southerly winds were noted on the western periphery of the ridge, with seas of 4-6 ft east of the Bahamas.

On 10 June at 0600 UTC a deep upper-level trough was over the eastern Gulf of Mexico and northeastern Florida. Strong divergent southwest flow south and east of the trough axis

[1] The Government of Bahamas has four excess rainfall policies: one for The Bahamas Central; one for The Bahamas Extreme North; one for The North and one for The Bahamas South East. This heavy rainfall did not affect the Extreme North, North or South – East areas and therefore the respective XSR policies for these regions were not triggered.

[2] The LET aims at identifying and covering events that did not cause very large national-scale losses but significantly affected a relatively small part of the country. It is based on the Local Index, which is the ratio between the average precipitation over the most impacted area and the national average precipitation.

[3] The WST aims at detecting rain events that happen after a long rainy spell, when the soil is already saturated. When a rainfall event happens after a particularly wet period, its effect is exacerbated by soil saturation. Rainfall events that take place on saturated soil can pose a significant risk to communities and infrastructure as they often result in rapid and unexpected runoff and increased flow velocity, causing widespread damage.

transported a large amount of moisture northward from the deep tropics, creating an atmospheric river over Cuba and The Bahamas. Together with convergent southerly winds at the surface, sporadic heavy showers and strong thunderstorms flared up over Cuba and The Bahamas. In the 24 to 48 hours preceding 0600 UTC, in The Bahamas, 8 inches (200 mm) of rainfall were reported on Exuma and 4 inches (100 mm) were reported on Long Island.

At 1200 UTC a deep upper-level trough occurred over Florida and the northwest Caribbean Sea. As before, divergent southwest flow east of the trough axis transported enhanced moisture northward from the deep tropics, creating an atmospheric river over Cuba and The Bahamas. Together with convergent southerly winds at the surface, sporadic heavy showers and strong thunderstorms again occurred over Cuba and The Bahamas.

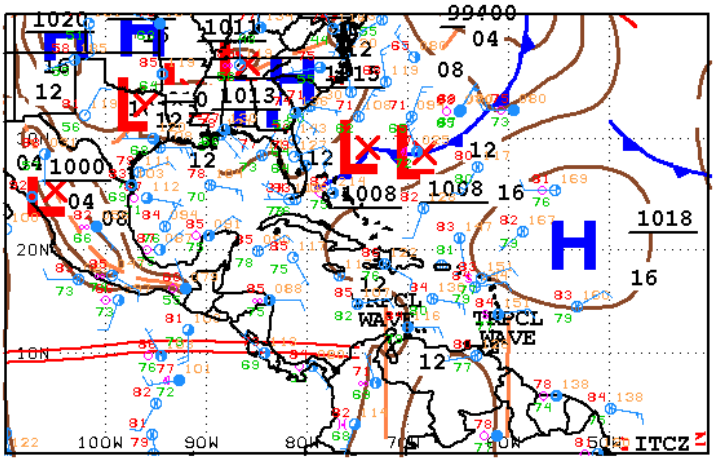
At 1800 UTC the upper level trough centered over the eastern Gulf of Mexico with southwest flow extending to the surface continued to maintain an atmospheric river over Jamaica, Cuba, and The Bahamas. Scattered moderate convection tapping into the atmospheric river occurred northeast of The Bahamas from 24N to 30N between 71W and 75W.

On 11 June at 0600 UTC the latest water vapour satellite imagery revealed decreasing moisture at the low to mid levels of the troposphere across Cuba and The Bahamas.

On 12 June at 0000 UTC a broad Atlantic surface ridge extended southwest from a 1021 mb high pressure area centred near 25N52W and extending to The Bahamas and the northeast Caribbean.

At 0600 UTC convergent southerly winds continued to couple with modest divergent winds aloft to generate scattered showers and isolated thunderstorms from the central Bahamas northeastward to near 28N69W.

At 1800 UTC, rain characterised as “widely scattered moderate” to “isolated strong” occurred between 70W and 86W, within Florida and from The Bahamas to northwestern Cuba and the eastern half of the Gulf of Mexico.



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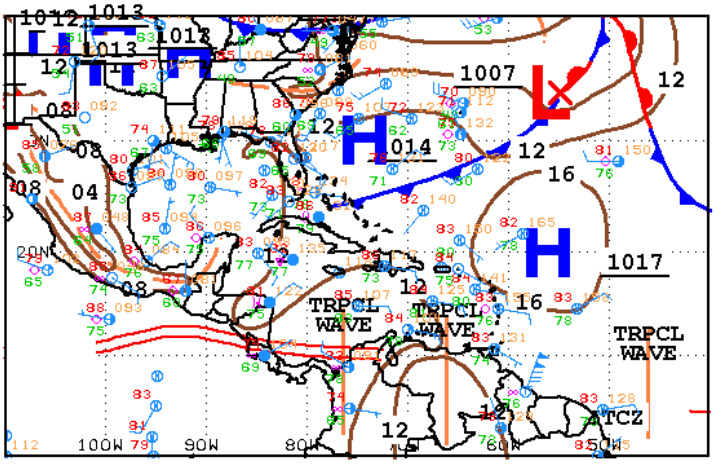
NATIONAL HURRICANE CENTER
MIAMI, FLORIDA
BY TAFB ANALYST: MT
COLLABORATING CENTERS: NHC OPC

06 June at 0000UTC



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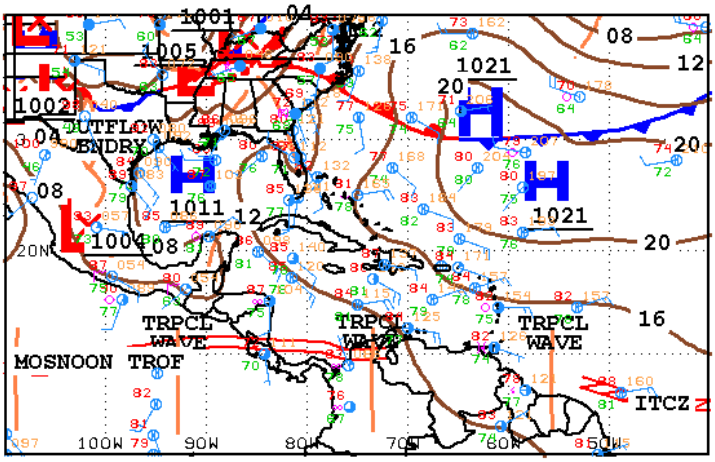
BY TAFB ANALYST: MT
COLLABORATING CENTERS: NHC OPC

07 June at 0000UTC



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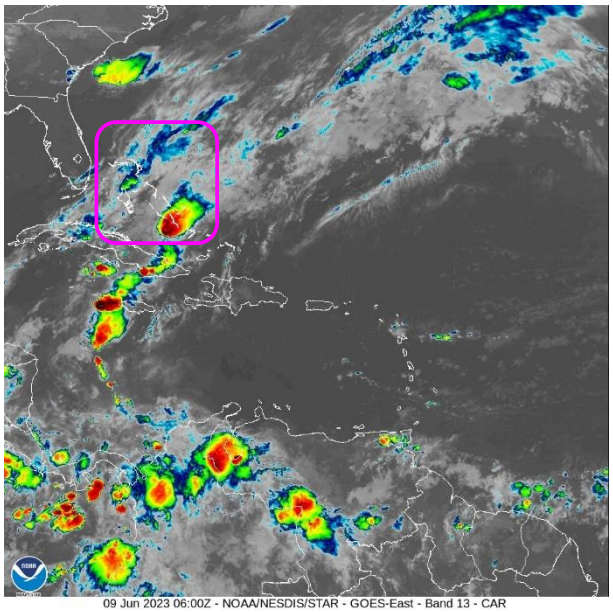
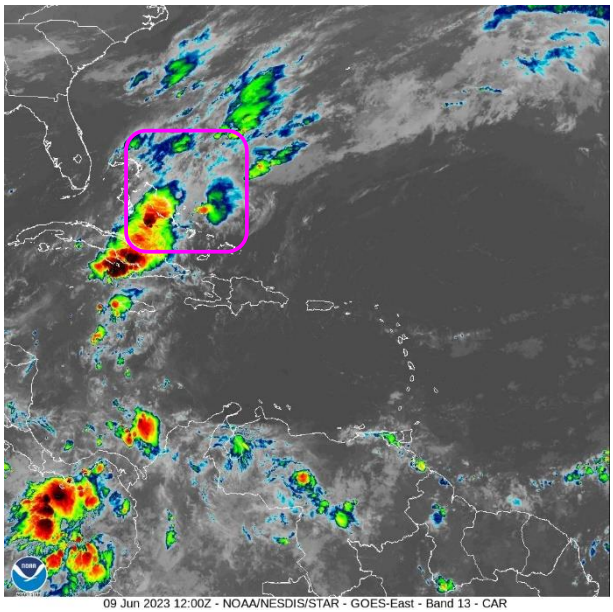
MIAMI, FLORIDA
BY TAFB ANALYST: PC
COLLABORATING CENTERS: NHC OPC

12 June at 0000UTC

Figure 1 Surface analysis over the Caribbean Sea on 06, 07 and 12 June 2023 at 0000 as indicated by the label. Source: US National Hurricane Center[4]

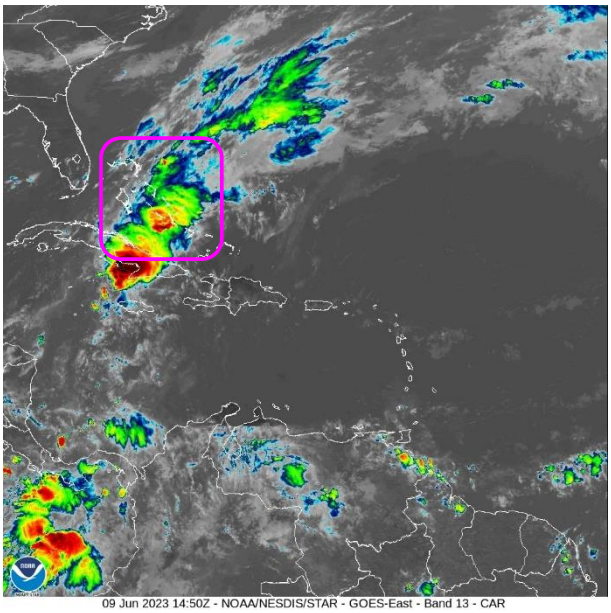


09 June at 0600UTC

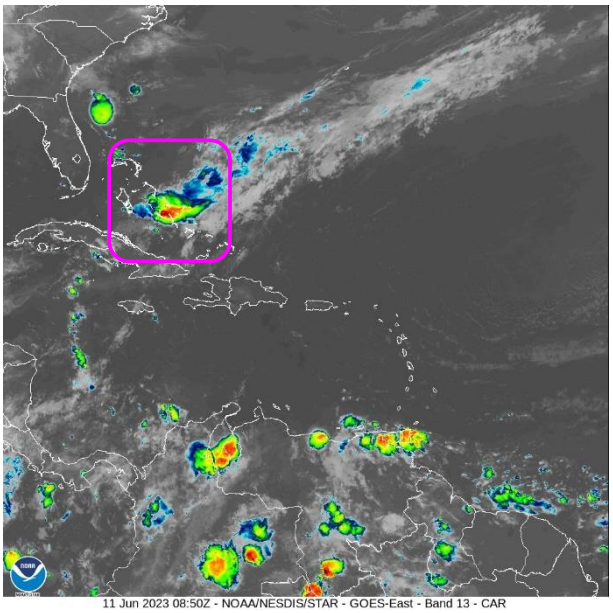


09 June at 1200UTC

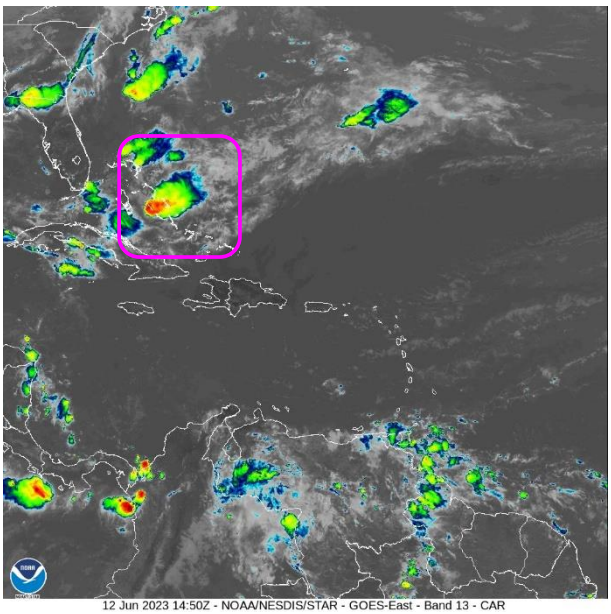
[4] National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, available on 07 June 2023 at: *https://www.nhc.noaa.gov/tafb/WATL_00Z.gif*



09 June at 1500UTC



11 June at 0900UTC



12 June at 1500UTC

Figure 2 Satellite imagery at different times as indicated by 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, National Environmental Satellite, GOES Image View[5]

[5] NESDIS Online Archive, NOAA National Environmental Satellite, GOES Image View, available at: *https://www.star.nesdis.noaa.gov/GOES/sector_band.php?sat=G16&sector=car&band=13&length=12*

3 IMPACTS

According to local news reports, the heavy rain resulted in flooding of homes, businesses and vehicles in Exuma .

Figure 3 Flood damage in Exuma

No additional information was available on damage or loss in The Bahamas due to this rainfall event.

4 RAINFALL MODEL OUTPUTS

Four of the six data sources used by the XSR 3.0 model, CMORPH[6], IMERG[7], WRF11 and WRF15[8], detected the occurrence of precipitation over the Bahamas Central and the surrounding waters during the period 6 to 13 June 2023. However, each data source reported a specific distribution and accumulation of rainfall, as discussed below. The CARE for the Bahamas Central was activated on 8 June and lasted for the period 8 - 13 June. The CARE was activated due to the use of the 12-hour and the 48-hour aggregation intervals for precipitation[9] and thus the period considered by the XSR 3.0 model for the loss estimate based on the accumulated precipitation in the Bahamas Central was 6 – 13 June.

CMORPH reported total accumulated amounts of precipitation below 320 mm in the entire

[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.

[4] 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 report.

[5] WRF5, 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 in the Definitions section of this report.

[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.

area of the Bahamas Central. The maximum values, between 280 mm and 320 mm, were in the northern area of Long Island and in two areas of Cat Island.

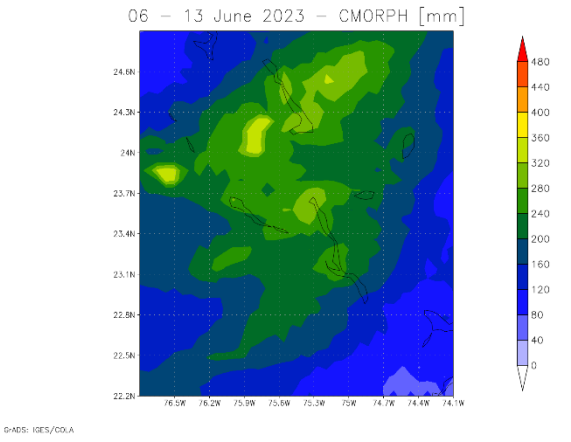
IMERG reported total accumulated amounts of precipitation higher than 160 mm in the entire area of the Bahamas Central. The maximum values, between 440 mm and 480 mm, were in the central area of Great Exuma Island.

WRF5 showed total accumulated values of precipitation between 0 and 80 mm in the entire area of the Bahamas Central. The maximum values between 40 mm and 80 mm were simulated in two small areas in Long Island, in the Black Islands, across almost the entire Cat Island and in two small areas of Great Exuma Island.

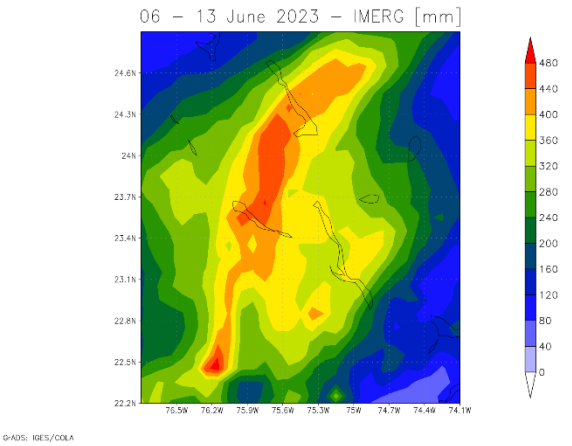
WRF7 simulated total accumulated values of rainfall between 0 and 80 mm in the entire area of the Bahamas Central. The maximum values between 40 mm and 80 mmwere simulated in the Black Islands, in the northern part of Cat Island, in two small areas in Long Island and in almost the entire Great Exuma Island. Values between 0 and 40 mm were reported over the rest of the Bahamas Central area.

WRF11 showed total accumulated values of precipitation up to 440 mm in the northern portion of Long Island and in the central area of Great Exuma Island.

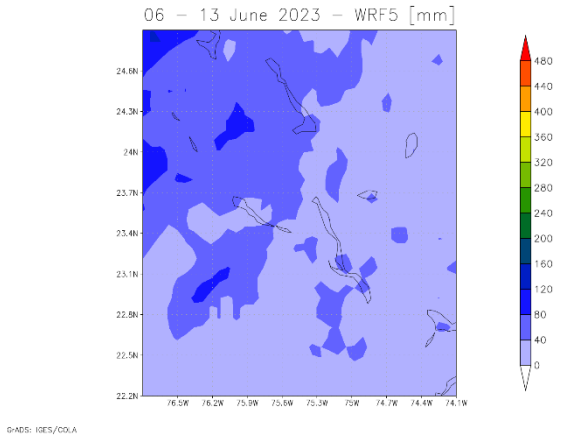
WRF15 simulated total accumulated values of rainfall higher than 160 mm in Cat Island, with maximum values, between 280 mm and 320 mm, in the northern portion of the Island. Values higher than 40 mm were reported over the rest of the Bahamas Central area.



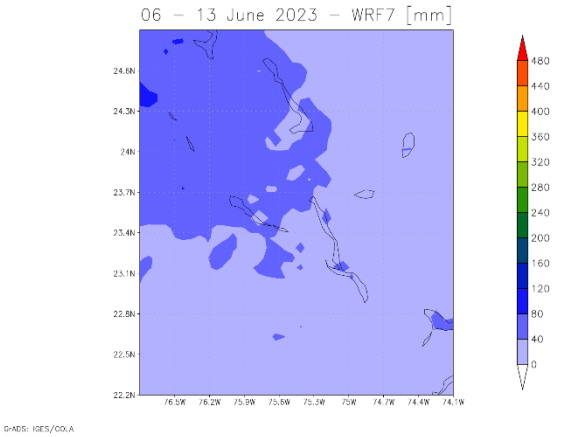
a) CMORPH



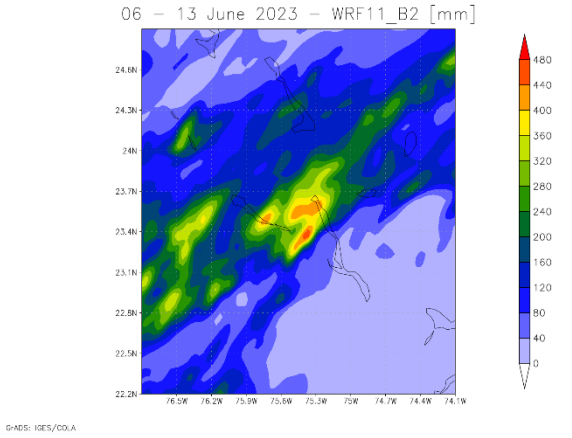
b) IMERG



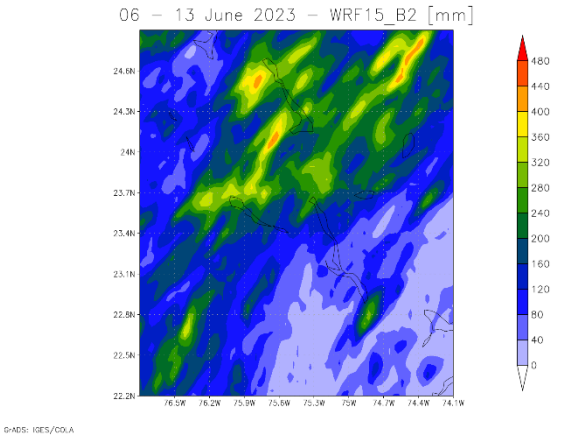
c) WRF5



d) WRF7



e) WRF11



f) WRF15

Figure 3 Total accumulated precipitation during the period 06 - 13 June, 2023
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/BHS/BHS_C/CARE_2_2023/daily_prec_short.mp4
https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/BHS/BHS_C/CARE_2_2023/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for the Bahamas Central for four data sources used by XSR3.0: CMORPH, IMERG, WRF11 and WRF15. The RIL was the highest for WRF15.

The final RIL (RIL_{FINAL}) was calculated as the average of the four RILs from CMORPH, IMERG, WRF11 and WRF15. 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 the excess rainfall policy for the Bahamas Central and therefore it did not trigger a policy payout.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) was below the attachment point of The Bahamas' Excess Rainfall policy for the Central region (Bahamas – Central) 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.
IMERG Model	The satellite-based rainfall estimation model developed by NASA as described in the Rainfall Estimation Models section of the Policy.
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.
WRF11 Model	The weather research and forecasting rainfall model by NOAA with Configuration #11 initialized with the data provided by the National Center for Environmental Prediction and based on the standard setup provided by the Caribbean Institute for Meteorology and Hydrology (CIMH) as described in the Rainfall Estimation Models and in the Input Data to the Rainfall Estimation Models sections of the Policy.
WRF15 Model	The weather research and forecasting rainfall model by NOAA with Configuration #15 initialized with and assimilating the data

	provided by the National Center for Environmental Prediction and based on the standard setup provided by the Instituto National de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH) of Guatemala, as described in the Rainfall Estimation Models and in the Input Data to the Rainfall Estimation Models sections of the Policy.
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.