CCRIF SPC
The Caribbean Catastrophe Risk Insurance Facility

Covered Area Rainfall Event (23/08/2020 to 25/08/2020)

Excess Rainfall

Event Briefing

Haiti

2 September 2020

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1 INTRODUCTION

Haiti was under the influence of Tropical Storm Laura during on 23 August resulting in adverse weather conditions, primarily heavy rainfall that occurred between 23 and 25 August, 2020, mainly over the southern portion of the country but including other sections as well.

This event briefing describes the impact of rainfall on Haiti, which was associated with a Covered Area Rainfall Event (CARE), starting on 23 August and ending on 25 August 2020. The Rainfall Index Loss (RIL) indicated government losses above the attachment point of Haiti's Excess Rainfall policy. Final calculations show that a payout of US$7,163,958.28 is due to the Government.

As reported in a separate tropical cyclone Event Briefing, "TC Laura: Haiti" dated 2 September 2020, Haiti experienced heavy rains and tropical-storm-force winds up to 47 mph (76 km/h) from the system. The final runs of the CCRIF SPHERA loss model for tropical cyclones produced losses due to wind impacts, which were below the attachment point of Haiti's Tropical Cyclone policy and no payout under that policy was due. However, the Aggregate Deductible Cover (ADC) for the Tropical Cyclone policy was activated since a disaster alert related to Tropical Cyclone Laura was declared by ReliefWeb[1] for Haiti. An ADC payment of US$290,925 was due under that feature of the policy.

2 EVENT DESCRIPTION

On 21 August 2020 at 1305UTC, the US National Hurricane Center (NHC) reported that a Tropical Storm named Laura developed ESE of the northern of Leeward Islands. The system was located over the tropical western Atlantic and presented a poorly organized structure with a low-defined convective band and a general ragged appearance of the cloud pattern. The estimated centre of circulation was located at 17.0N 59.8W, to the east-southeast of the northern Leeward Islands. The minimum central pressure was 1008 mb and the maximum sustained winds were estimated at 45 mph (75 km/h). The system moved towards the west along the south periphery of the Bermuda-Azores high pressure system located over the Atlantic Ocean. Its forward velocity was estimated at 18 mph (30 km/h) and it was directed towards the northern Leeward Islands. On the same day at 2100UTC, the centre of Laura passed over the northern Leeward Islands (17.1N 61.2W), with a force and an appearance generally unchanged. In the following hours, the tropical storm left the Leeward Islands heading for the Caribbean Sea. The system moved with slightly increased forward velocity (21 mph, 33 km/h) towards the west-northwest in the direction of the island of Hispaniola.

On 23 August at 0600UTC, the centre of Tropical Storm Laura was at 18.6N 70.1W, at a distance of 145 mi (230 km) from Port-au-Prince, Haiti (Figure 1). The cloud pattern of the system appeared more organized, with a well-defined centre of circulation and rain bands surrounding it (as shown in Figure 2), the estimated maximum sustained winds were slightly increased to almost 50 mph (85 km/h) and the minimum central pressure decreased to 1004 mb. The system was moving toward the west-northwest near 18 mph (30 km/h) and six hours later at 1200UTC,

[1] ReliefWeb - informing humanitarians worldwide – Disaster Alert by Tropical Cyclone Laura available at: *https://reliefweb.int/taxonomy/term/50413*

the centre of Laura was located over Haiti at 19.1N 72.1W (Figure 1). The heavy precipitation associated with the tropical storm rain bands affected Haiti from 23 August at 0200UTC until 2300UTC, when the tropical storm left the island of Hispaniola, and moved towards Cuba. The most intense rainfall affected the southern portion of Haiti and to a lesser extent the central portion, while the northern portion of the country experienced mainly moderate rainfall during the passage of the tropical storm (Figure 2). This was caused by the displacement of the bulk of the deep convection mostly into the southern semicircle of Laura's circulation, as shown by the satellite image in Figure 2.

On 24 and 25 August, isolated showers developed over Haiti due to the unstable and moist environment remaining over the island of Hispaniola after Laura's passage.

On 25 August at 1215UTC, Laura became a hurricane, when its centre was located over the southeastern Gulf of Mexico with maximum sustained winds near of 75 mph (120 km/h) with significant strengthening during the following hours. Twenty-four hours later, Hurricane Laura intensified while moving over the central waters of the Gulf of Mexico, becoming a category 3 hurricane and the first major hurricane of the 2020 Atlantic Hurricane Season.

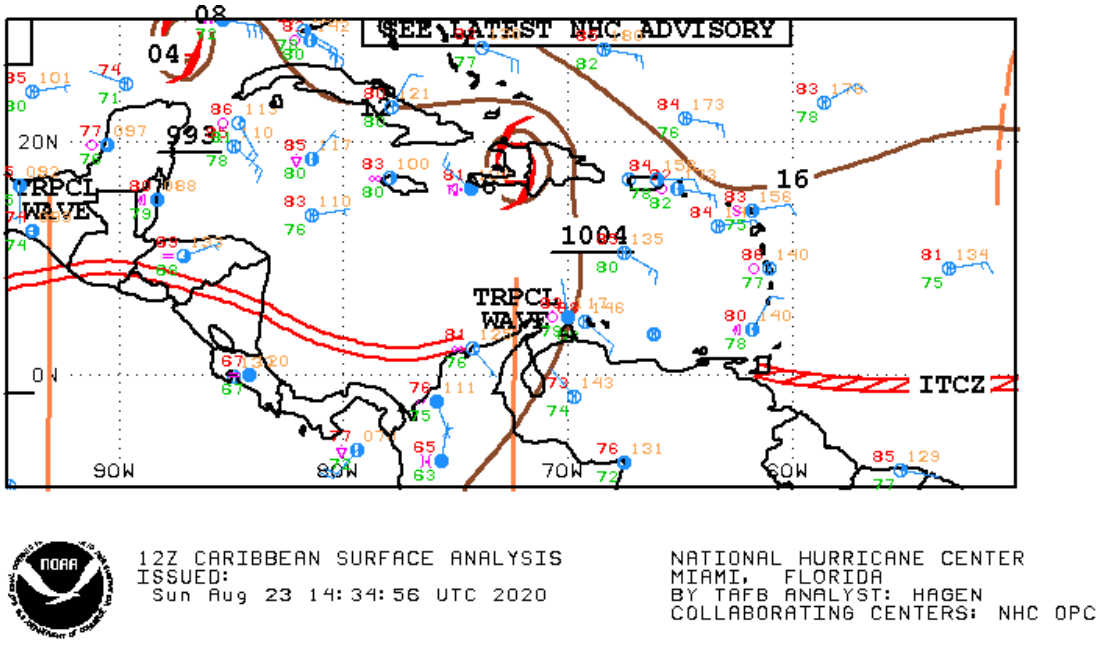


Figure 1 Surface analysis over the Caribbean area on 23 August at 1200UTC. Tropical Storm Laura is visible over Haiti. Source: US National Hurricane Center[2]

[2] National Oceanic and Atmospheric Administration - FTP, National Hurricane Center, review date: 23 August 2020, available at: *https://www.nhc.noaa.gov/tafb/CAR_12Z.gif*

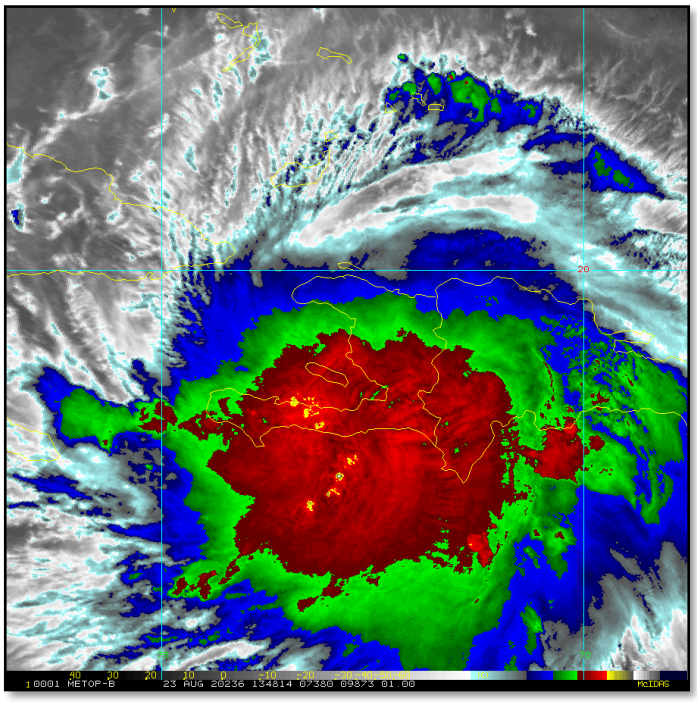


Figure 2 Satellite imagery on 23 August at 1348UTC from thermal infrared channel enhanced with colour. Blue/green colours represent high altitude clouds (top cloud temperature between -50°C and -70°C), while the red/yellow colours represent very high altitude clouds (top cloud lower than -70°C). High altitude clouds indicate strong convection associated with intense precipitation. Source: NOAA, National Environmental Satellite, Data and Information Service[3].

3 IMPACTS

According to the assessments provided by Haiti's Direction de la Protection Civile, development partners and other sources[4] [5], the entire country was affected in some way by wind and rainfall due to Tropical Storm Laura, with the most significant impacts due to rainfall.

Reported impacts at the time of this report include the following:

- 31 persons lost their lives, with another 8 persons missing
- Approximately 44,175 persons from 8,835 households were affected
- 28 cities/parishes in 4 departments were impacted:
    - Nippes: Miragoane, Baradères
    - Ouest: Port-au-Prince, Carrefour, Cité Soleil, Delmas, Léôgane, Fond Verrettes Ganthier, Tabarre, Pétionville

[3] RAMSDIS Online Archive, NOAA Satellite and Information Service, review date: 23 August 2020, available at: *http://rammb.cira.colostate.edu/ramsdis/online/archive.asp?data_folder=tropical/tropical_ge_14km_wv&width=640&height=480*

[4] New Orleans, LA Local news – NOLA.com, review date: 26 August 2020, available in: *https://www.nola.com/*

[5] ZIZ Broadcasting Corporation – zizonline, review date: 26 August 2020, available in: *https://zizonline.com/*

    - Sud : Cayes, Chardonnières, Côteaux, les Anglais, Port Salut, Port à Piment, Roche à bateau, Saint jean du Sud, Tiburon
    - Sud-Est: Anse à Pitres, Bainet, Belle-Anse, Cayes-Jacmel, Jacmel, Marigot, La Vallée, Thiotte
- 6,272 homes were flooded, including 2,320 which suffered some damage and 243 which were destroyed
- Several communities were evacuated
- Destruction of agricultural crops and the death of livestock occurred in the Sud Est, Sud, Artibonite, Grand'Anse, Nippes, Nord, Ouest, and Nord Ouest departments
- Numerous roads and bridges were damaged, destroyed or blocked
- Telecommunication services were temporarily interrupted
- Port-au-Prince's Toussaint Louverture International Airport was flooded
- Several hospitals were short-staffed due to impassable roads
- A health centre in Anse-à-Pitre was flooded

Prior to the arrival of Tropical Storm Laura, Haiti's authorities took precautionary measures such as activating a Tropical Storm Warning and opening the official emergency shelters.

Figure 3 shows some of the flood damage caused by Tropical Storm Laura in Haiti.

Figure 3 Flood damage caused by Tropical Storm Laura in Haiti – August 23-25, 2020
Source: *New Orleans, LA Local news*, *Voice of America* and *CBC/Radio-Canada*

4 RAINFALL MODEL OUTPUTS

All three data sources used by the XSR 2.5 model, CMORPH[6], WRF5 and WRF7[7], simulated the occurrence of precipitation associated with Tropical Storm Laura over Haiti and the surrounding waters during the period 23-25 August 2020. However, each data source reported differing distributions of rainfall, as discussed below.

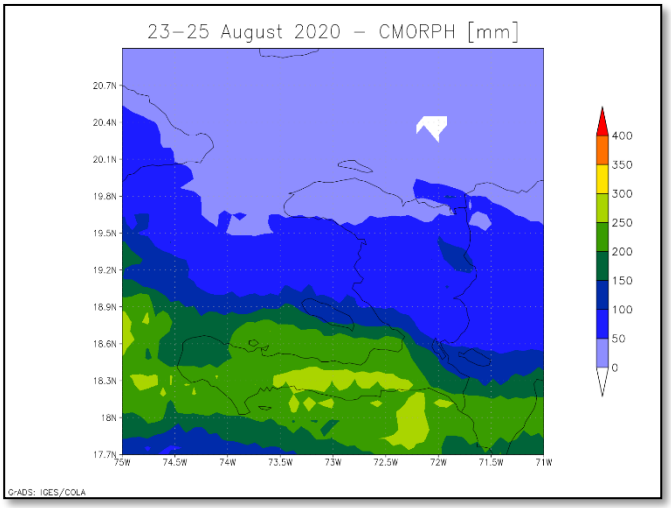
CMORPH reported total accumulated amounts of precipitation higher than 50 mm over most of Haiti. The largest values of precipitation were shown over the southern portions with values between 100 mm and 300 mm.

WRF5 simulated total accumulated amounts of rainfall with values greater than 50 mm mainly along the south coast of Haiti. However, it reported a high peak in a localized area in the south-east part of the country (close to the border with the Dominican Republic) with amounts between 300 mm and 350 mm.

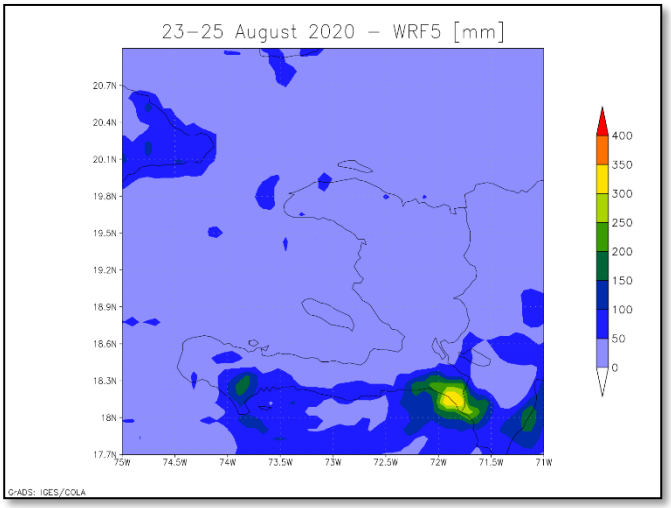
WRF7 showed total accumulated amounts of precipitation higher than 50 mm over the southern and central areas of Haiti. The largest values of precipitation ranged between 100 mm and 150 mm in the southern portion of the country and in the vicinity of the capital Port-au-Prince.

[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.

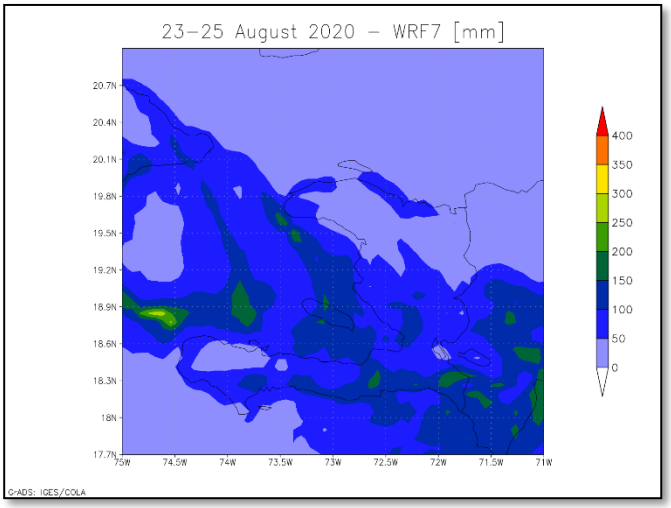
[7] WRF5 and WRF7 Models: the Weather Research and Forecasting Model weather model-based Configuration #1 and #2 data *https://www.mmm.ucar.edu/weather-research-and-forecasting-model*. These data are initialised by the NCEP FNL dataset. (NCEP FNL Operational Model Global Tropospheric Analyses [*http://rda.ucar.edu/datasets/ds083.2/*]).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



a) CMORPH



b) WRF5



c) WRF7

Figure 4 Total accumulated precipitation during the period August 23-25, 2020 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/HTI/CARE_6_2020/daily_prec_short.mp4

https://wemap.ccrif.org/OUTPUT/CCRIF/XSR/Events/HTI/CARE_6_2020/daily_prec_long.mp4

The Rainfall Index Loss (RIL) was above the loss threshold for Haiti for all three data sources used by XSR2.5: CMORPH, WRF5 and WRF7. The RIL was highest for CMORPH due to the higher amounts of accumulated precipitation presented over the capital Port-au-Prince and surroundings, an area characterized by high exposure.

The final RIL (RIL_{FINAL}) was calculated as the average of the RILs for the CMORPH, WRF5 and WRF7 data sources. The RIL_{FINAL} was higher than the attachment point of the Excess Rainfall policy for Haiti, and therefore this event was classified as a triggering event thus resulting in a payout.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event (CARE) that started on 23 August and ended on 25 August 2020, produced government losses which were above the attachment point of Haiti's Excess Rainfall policy. Final calculations show that a payout of US$7,163,958.28 is due to the Government.

CCRIF expresses sympathy with the Government and people of Haiti for the loss of life and impacts on communities and infrastructure caused by this event.

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.