Covered Area Rainfall Event (17/06/2019 to 19/06/2019)

Excess Rainfall

Event Briefing

Trinidad and Tobago - Trinidad

28 June 2019

1 INTRODUCTION

A tropical wave and an active Inter-Tropical Convergence Zone (ITCZ) produced prolonged periods of rain/showers and thunderstorm activity over Trinidad and Tobago between 17 and 19 June 2019, generating adverse weather in Trinidad.

This event briefing describes the impact on the island of Trinidad of the heavy precipitation received during this period. The Rainfall Index Loss (RIL) calculated for this Covered Area Rainfall Event (CARE), which occurred in Trinidad, starting on 17 June and ending on 19 June 2019. The RIL calculated for this CARE was below the attachment point of Trinidad's Excess Rainfall policy and therefore no payout is due.

2 EVENT DESCRIPTION

From 17 to 19 June, the consecutive passage of three tropical waves over the south-east Caribbean Sea and the presence of the intertropical convergence zone over the waters of Guyana led to the development of showers and thunderstorms in an area between the waters of Guyana and Venezuela (Figure 1). In particular, Trinidad and Tobago were affected by scattered to moderate thunderstorms on 17 June from 630UTC to 1830UTC (during this interval a few nuclei of intense precipitation were also observed), on 18 June from 545UTC to 2000UTC and on 19 June from 830UTC to 2115UTC (Figure 2). These three intervals broadly correspond to the passages of the three tropical waves (the first one is reported in Figure 1).

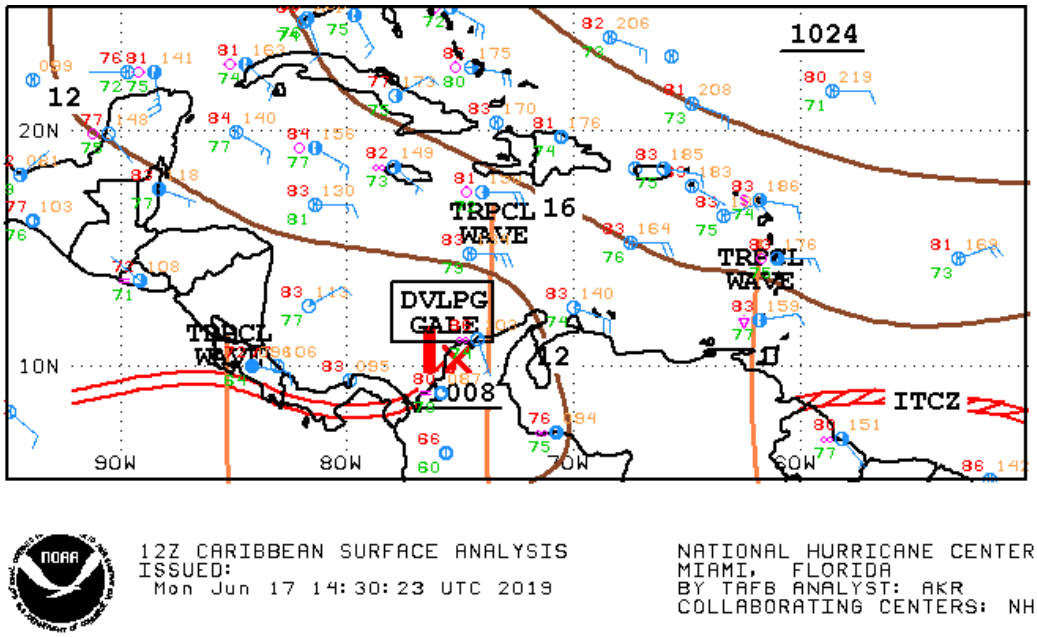
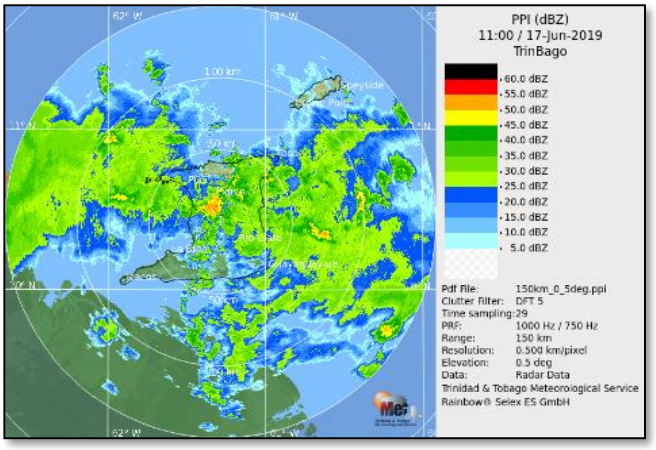
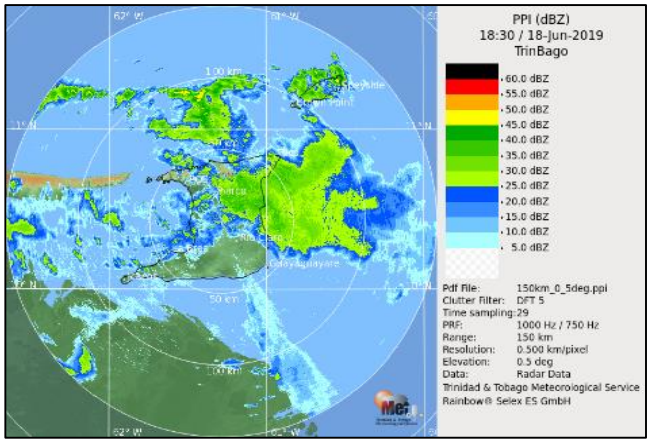


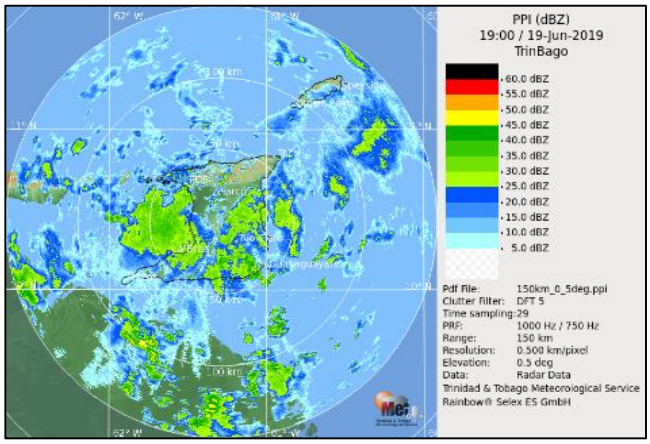
Figure 1 Surface analysis on 17 June at 1430UTC over the Caribbean Sea showing the intertropical convergence zone over the Guyana waters and the tropical wave in its eastward movement passing over Trinidad and Tobago. Almost the same configuration repeated approximately at same time also on 18 June and on 19 June. Source: NOAA, *https://ocean.weather.gov*



a) 17 June at 1100UTC



b) 18 June at 1830UTC



c) 19 June at 1900UTC

Figure 2 Reflectivity maps from the radar centered over Trinidad at different times corresponding to the most intense precipitation on days 17-18-19 June as indicated by the legend. Colours indicate the reflectivity, function of the intensity of precipitation (green is for moderate, while yellow/red are for intense)

Surface measurements from the GSOD dataset (Global Surface Summary of the Day - *https://www1.ncdc.noaa.gov*) report higher amounts of precipitation at Piarco, in the centre of Trinidad than at the international airport in Tobago. In particular, at Piarco the rain gauge recorded 107 mm total accumulated precipitation between 17 and 19 June.

Table 1 Surface measurements from GSOD dataset (*https://www1.ncdc.noaa.gov*)

	17 June	**18 June**	**19 June**
ARTHUR NAPOLEON RAYMOND ROBIN (11.15N, 60.8W) – Tobago (south-west)	7 mm	20 mm	8 mm
PIARCO (10.6N,61.3W) – Trinidad (central-north)	54 mm	30 mm	23 mm

The satellite-derived estimate of precipitation by the IMERG (Integrated Multi-satellitE Retrievals for GPM) dataset is in perfect agreement with the surface observations (Figure 3). Higher values for precipitation are reported for Trinidad, while lower values are reported for Tobago. In Trinidad, the peak of cumulated precipitation during the period 17-19 June is 140-160 mm, located over the central-eastern region of the island.

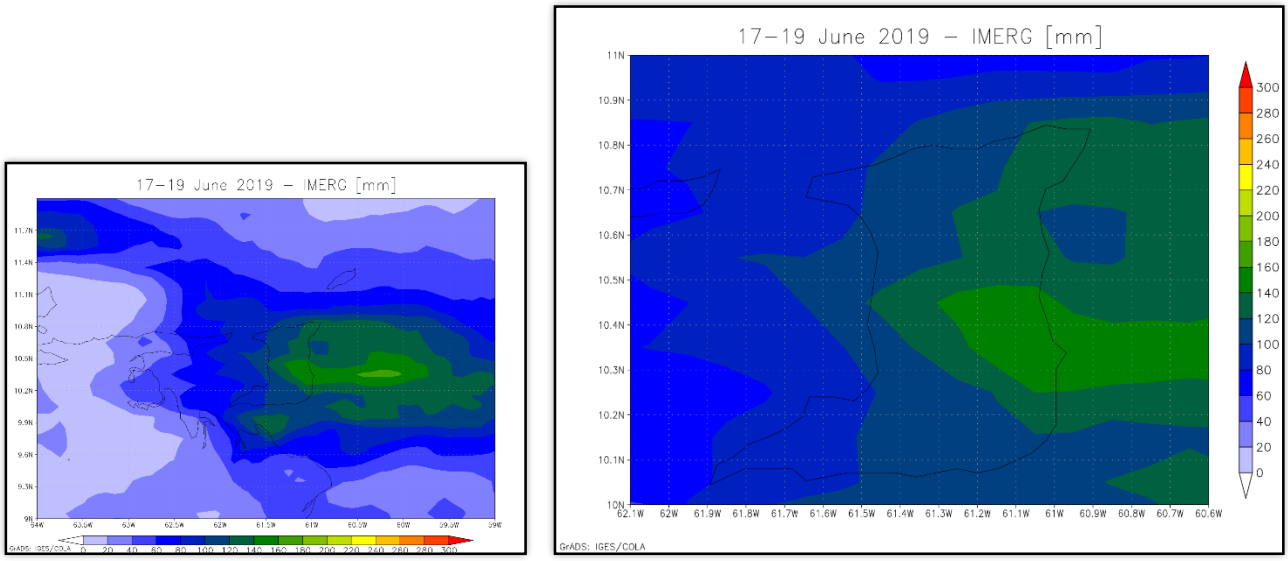


Figure 3 IMERG accumulated precipitation (rainfall) at 10 km resolution over Trinidad between 17 and 19 June 2019 on a wide and more local window. Source: XSR Web

3 IMPACTS

According to a report from the Office of Disaster Preparedness and Management (ODPM), the levels of some rivers such as El Mamo, Aripo, Caroni, Tumpuna and Mausica were slightly elevated.

The majority of the reports pertained to interruption of power for thousands of residents in at least 20 communities across Trinidad. There were reports of street floods along the Chaguanas main road. In Santa Flora, along the Erin Road, a tree fell across the roadway making it impassable. According to an official from the Penal/Debe Regional Corporation, there were no reports of flooding or property damage due to the inclement weather in that area.

The Trinidad and Tobago Meteorological Service (TTMS) activated the Adverse Weather Alert on Sunday 16 June.

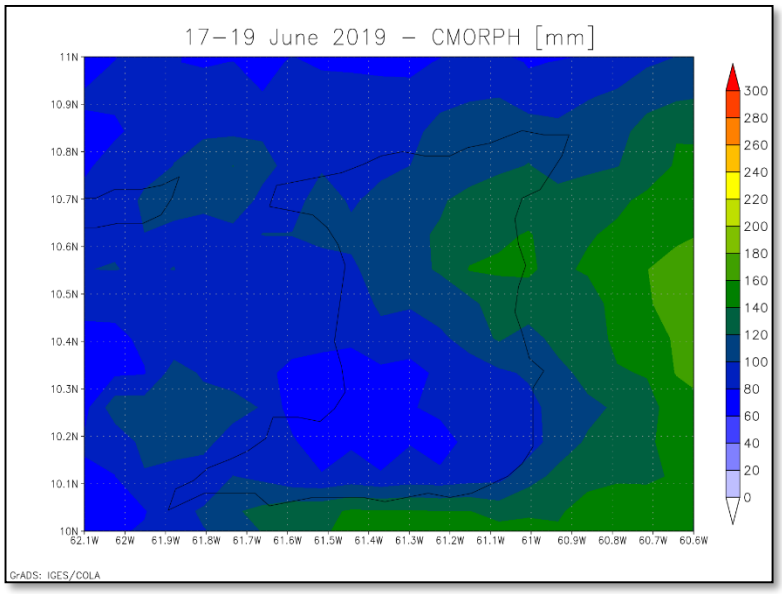
Figure 4 shows some flood damage caused by this combination of a tropical wave and the Inter-Tropical Convergence Zone in Trinidad.

Figure 4 Damage caused by heavy rainfall in Trinidad – June 2019
Sources: *Trinidad Express Newspapers*, and *Newsday*

4 RAINFALL MODEL OUTPUTS

All three models, CMORPH[1], WRF5 and WRF7[2], simulated the occurrence of showers over Trinidad and the surrounding waters during the period 17-19 June 2019. However, they differ in the spatial localization and intensity of the precipitation.

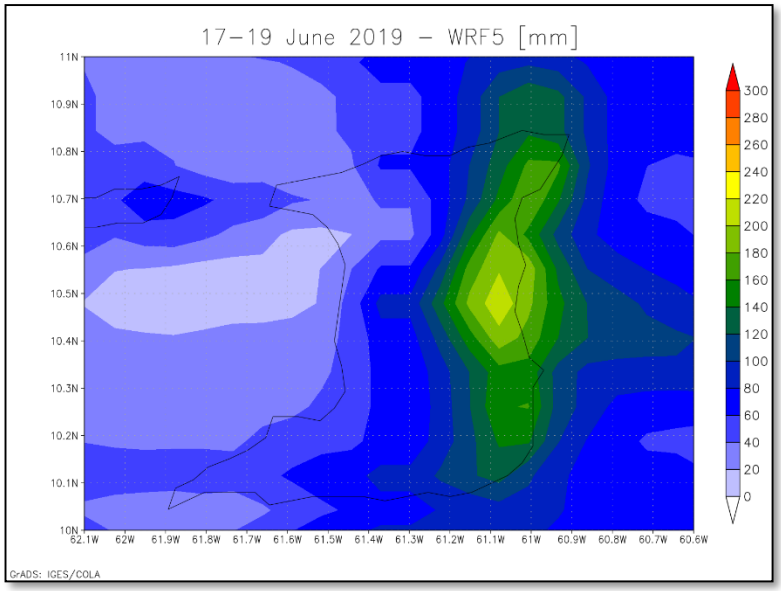
CMORPH reports a total cumulated precipitation very similar to the one of IMERG, with maximum precipitation of about 140-160 mm over the central eastern region (Figure 5). WRF5 presents larger values over the east side (maximum of 200-220 mm), and lower values over the internal region. Finally, WRF7 shows much lower amounts over Trinidad, since it simulates the more intense precipitation over the surrounding waters.



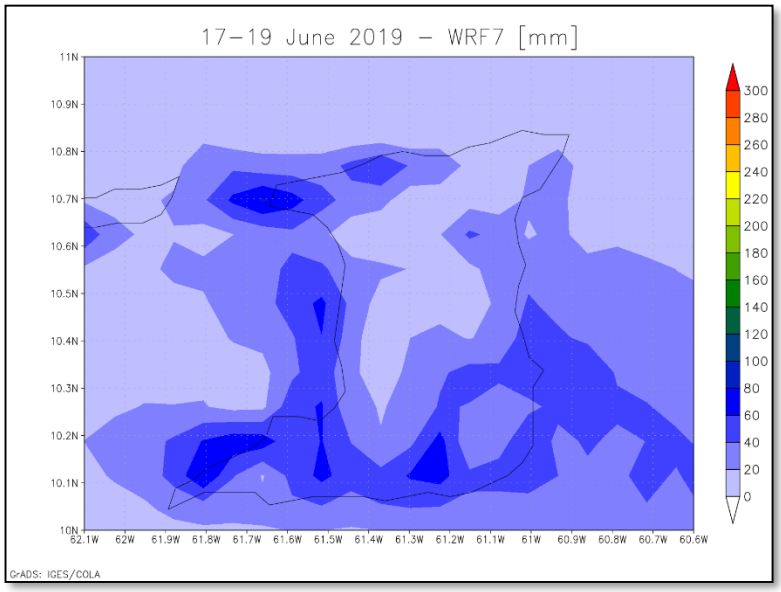
a) CMORPH

[1] 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.

[2] 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.



b) WRF5



c) WRF7

Figure 5 Total accumulated precipitation during the period 17-19 June 2019 estimated by CMORPH (a), WRF5(b) and WRF7(c)

Daily rainfall maps by CMORPH, WRF5 and WRF7 over the exposure map of XSR 2.5 are not herein reported as they can be downloaded at the following links for 12 hours aggregation and 48 hours aggregation respectively:

http://redrisk.webfactional.com/OUTPUT/CCRIF/XSR/Events/TTO/TTO_TRI/CARE_1_2019/daily_prec_short.mp4

http://redrisk.webfactional.com/OUTPUT/CCRIF/XSR/Events/TTO/TTO_TRI/CARE_1_2019/daily_prec_long.mp4

The final RIL is equal to US$12,340,212.61. It is the average of RIL_{CMORPH}= US$18,273,160.90 and RIL_{WRF5}= US$6,407,264.40, while RIL_{WRF7} is below the loss threshold (US$3,600,000). Despite CMORPH reporting a lower maximum rainfall accumulated during the event compared to WRF5, it produces a larger RIL because it also affects with significant precipitation the central and western area of Trinidad, which is characterized by high exposure. The Standardized Precipitation Index (SPI) was negative over the whole island, thus it does not influence the RIL computation.

Given that the final RIL is below the attachment point for Trinidad, this event qualifies as a loss event, but does not trigger any payout.

5 TRIGGER POTENTIAL

The Rainfall Index Loss calculated for this Covered Area Rainfall Event was below the attachment point of Trinidad's Excess Rainfall policy and therefore no payout is due.

CCRIF expresses empathy with the Government and people of Trinidad and Tobago for the impacts on communities and infrastructure caused by this event.

For further information, please contact ERN-RED, the CCRIF SPC Risk Management Specialist at the official email: monitor.xsr2@ccrif.org

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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.