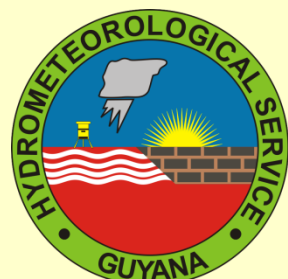


Monthly Bulletin

Ministry of Agriculture

Hydrometeorological Service

April 2018



"To observe, archive and understand Guyana's weather and climate and provide meteorological, hydrological and oceanographic services in support of the Guyana needs and national and international obligations."

HYDROMETEOROLOGICAL BULLETIN

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Highlights

- ❖ Guyana classified as *Very Dry* for March 2018
- ❖ Observed rainfall Significantly less than Historical Average – *Several stations recorded rainfall amounts more than 50% below average.*
- ❖ Warmer than average conditions dominated across much of the Earth's surface: Fifth highest March temperature recorded in 139 years.
- ❖ Little can be said at this time about the Weather Condition for period April – June, 2018. Chance for extremely wet condition a bit higher than usual.
- ❖ La Niña is expected to transition to ENSO-neutral during April-May

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Below: Caribbean Climate Outlook Forum (CariCOF) being hosted in Guyana by the Hydrometeorological Service



Review of Synoptic Systems that influenced the Weather Conditions for March 2018

During March 2018, there was a significant reduction in rainfall, which was somewhat attributed to the suppressed phase of the Madden Julian Oscillation (MJO)¹. In addition to the MJO, the Sub Tropical High Pressure System was the dominant synoptic feature. This produced strong subsidence which contributed to a dry atmosphere along with the interaction of the dust advected from the Saharan Air Layer (SAL) resulted significantly in the inhibition the development of cloud.

The Sub Tropical High maintained a tight pressure gradient, producing strong winds mainly along the coast and near inland locations. At the upper level

of the atmosphere, strong westerly to south westerly winds were observed. This resulted in vertical wind shear, further minimizing the chances of convective cloud development.

Notwithstanding the above mentioned dominant systems, a few instances in which the passages of weak low to mid-level troughs, shallow localized conditions, weak to moderate instabilities along with influences of the Sub Tropical Jet and moisture plumes embedded in the trade winds produced scattered showers.

During this period, the Inter Tropical Convergence Zone (ITCZ) was located to the east of Guyana.

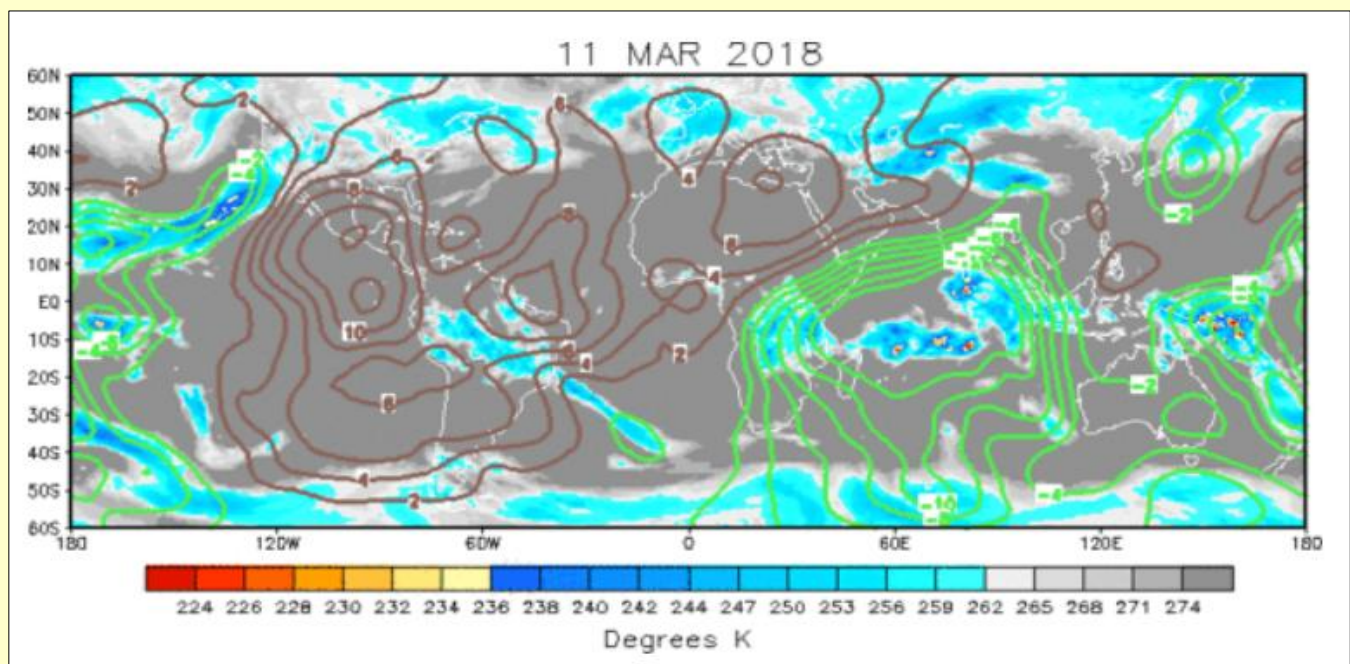


Figure 1 Map showing the MJO potential for precipitation during March 2018 with Positive anomalies (brown contours) indicating unfavorable conditions for precipitation while Negative anomalies (green contours) indicating favorable conditions for precipitation.

¹ The Madden-Julian Oscillation (MJO) is the major fluctuation in tropical weather on weekly to monthly timescales. The MJO can be characterized as an eastward

moving 'pulse' of cloud and rainfall near the equator that typically recurs every 30 to 60 days

During the first half of the month, Ridging at the mid and upper level coupled with the dust advected from the Saharan Dust Layer (SAL) to produce subsidence that reduced the moisture in the

atmosphere; additionally, strong vertical wind shear hindered the development of clouds significantly giving way for mostly sunny skies throughout Guyana..

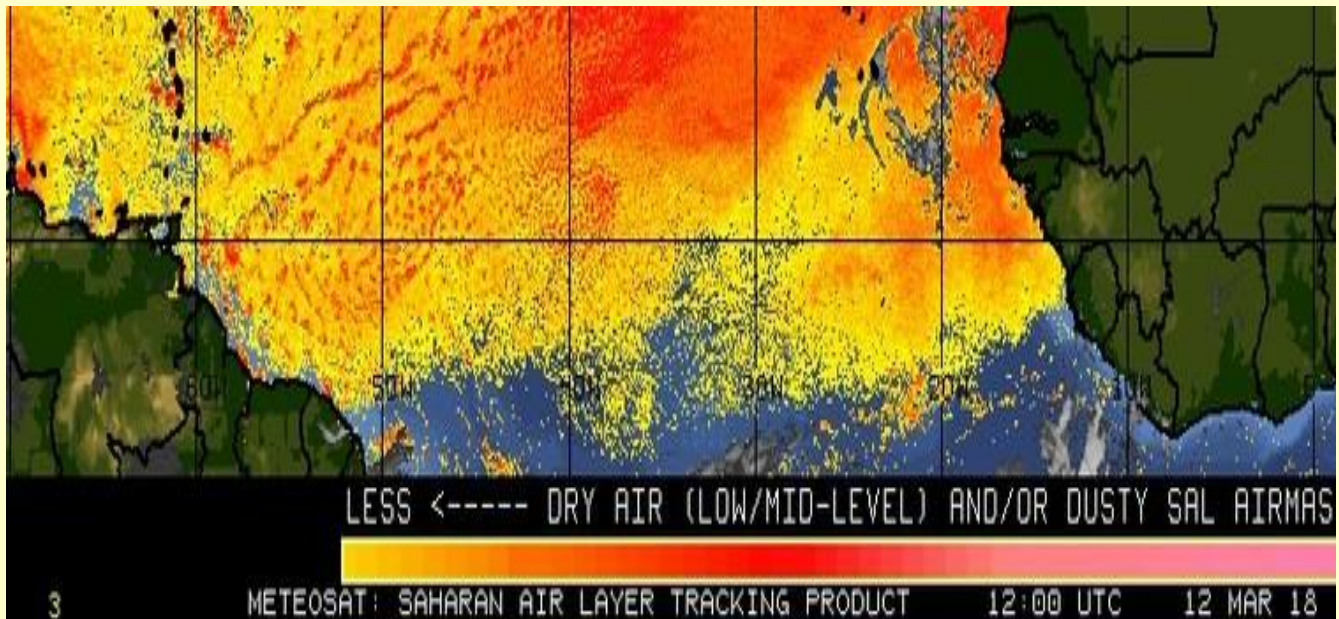


Figure 2 Satellite image of Saharan Air Layer (valid March 12, 2017) showing dust in the atmosphere along Guyana's Coast.

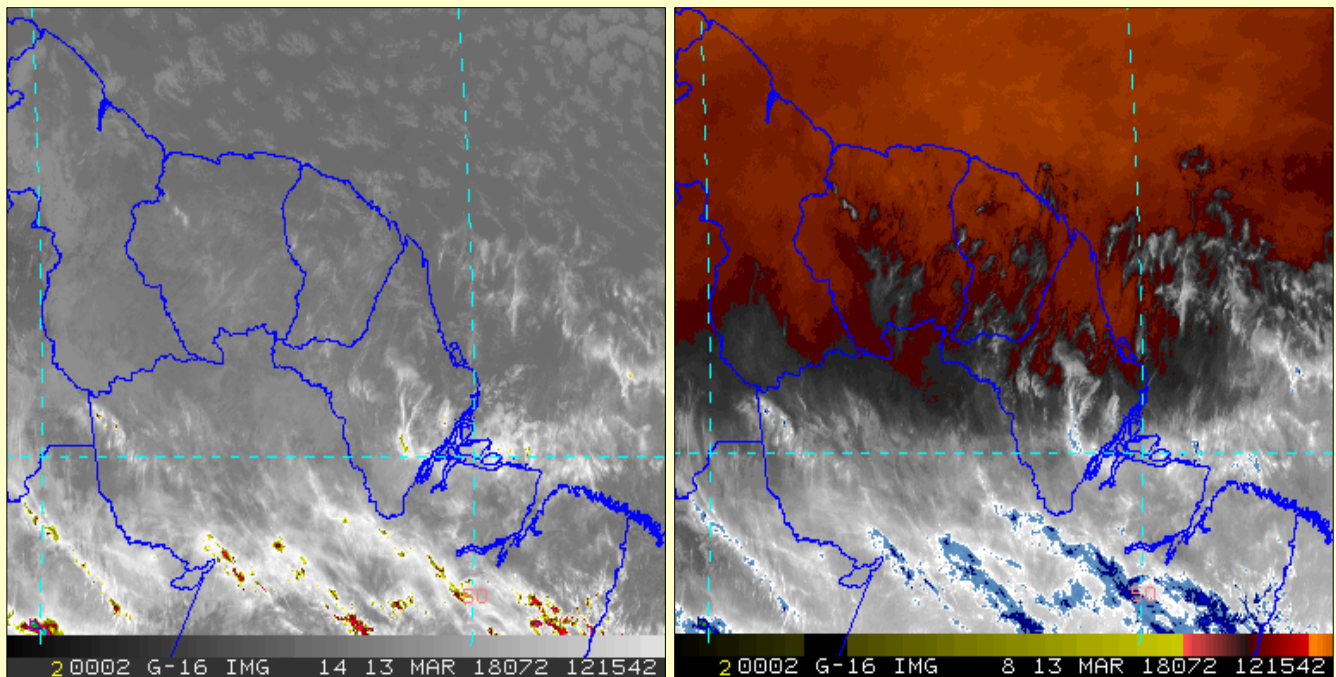


Figure 3 Satellite image (valid March 13, 2018) showing shallow clouds and a very dry atmosphere throughout Guyana.

Boerasirie on the West Coast of Demerara in Region 3 recorded 59.0 mm on March 02, 2018 which was the highest amount during this period

the rainfall observed was as a result of weak to moderate instabilities as shown in below

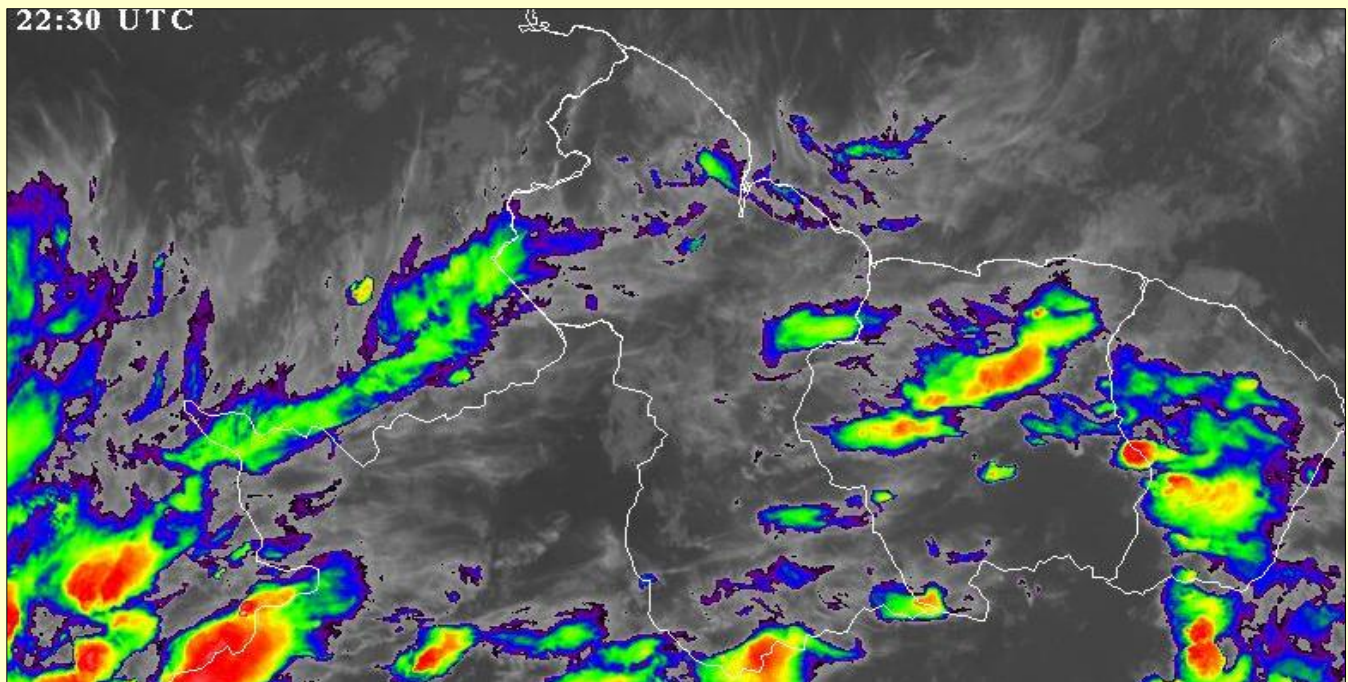


Figure 4 Satellite image (valid March 02, 2018) showing scattered convective and layered clouds associated with moderate instabilities.

The weather condition during second half of the month was influenced by a low to mid-level trough, which produced cloudy to overcast skies over

northern Guyana. During this period, the highest one – day rainfall for the month was recorded along the Essequibo Coast in Region 2.

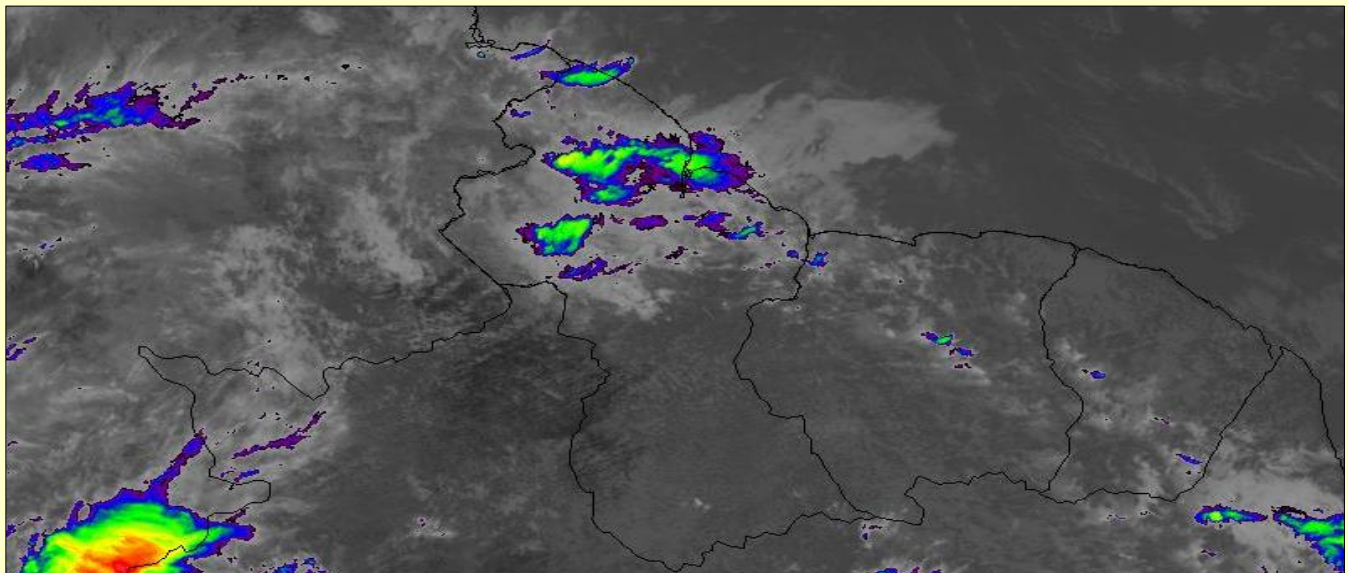


Figure 5 Satellite image (valid March 21, 2018) showing moderate convective clouds associated with a low to mid-level trough.

Review of Seasonal Outlook provided in February 2018.

Below is a brief review of the Seasonal Outlook for Guyana which was provided by the Hydrometeorological Service during February 2018.

Precipitation: Model output for March – May had suggests higher chances of above-normal rainfall from Region 5 to Northern Region 6 along with Central to North Rupununi. All other areas across Guyana should have expected near – normal rainfall.

Guyana usually experiences 30 to 47 wet days ($\geq 1.0\text{mm}$) during this period, the forecast had

suggested 29 to 48 wet days, with at least 2 extreme wet spell.

Temperature: Mean maximum and minimum temperatures across Guyana was expected to be slightly less than

Drought: Drought was not a concern for the outlook period. Rainfall received over the previous months along with the forecast above-normal rainfall during the outlook season would have been enough to recharge reservoirs, conservancies and aquifers to satisfactory levels.

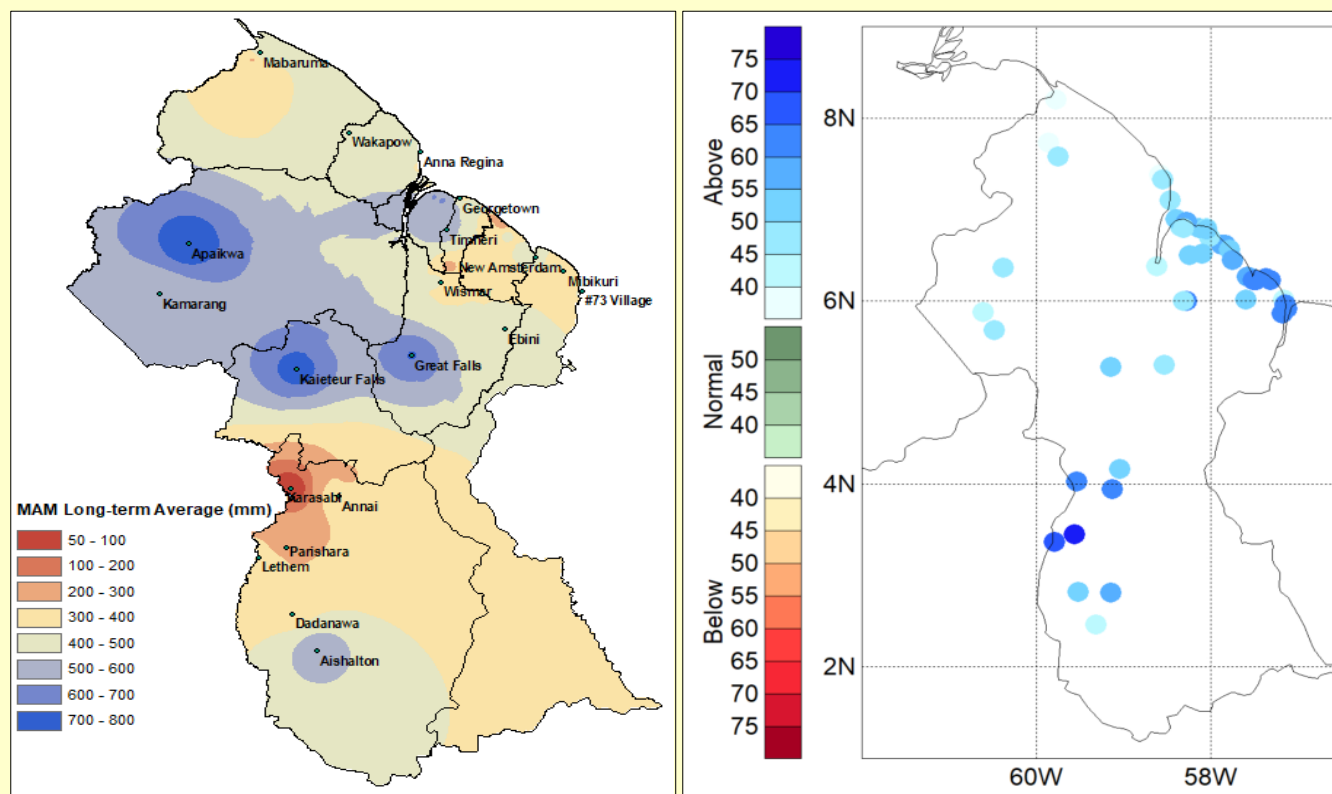


Figure 6 Maps of Guyana showing (a) Climatological Normal and (b) probabilistic seasonal forecast² (chances of occurrence) across Guyana for period March – May 2018.

²The forecast and projection above was prepared taking into account the usual Climatological trends along with current dynamical models and Climate Prediction Tools (CPT)

March 2018 Rainfall Analysis

Guyana was classified as *Very Dry* (MD) for the month of March 2018, with a nationwide average rainfall of 52.7 mm distributed over 6 rain days A

detailed comparison of the March 2018 rainfall with the historical average for selected stations can be seen in Figure 7 below.

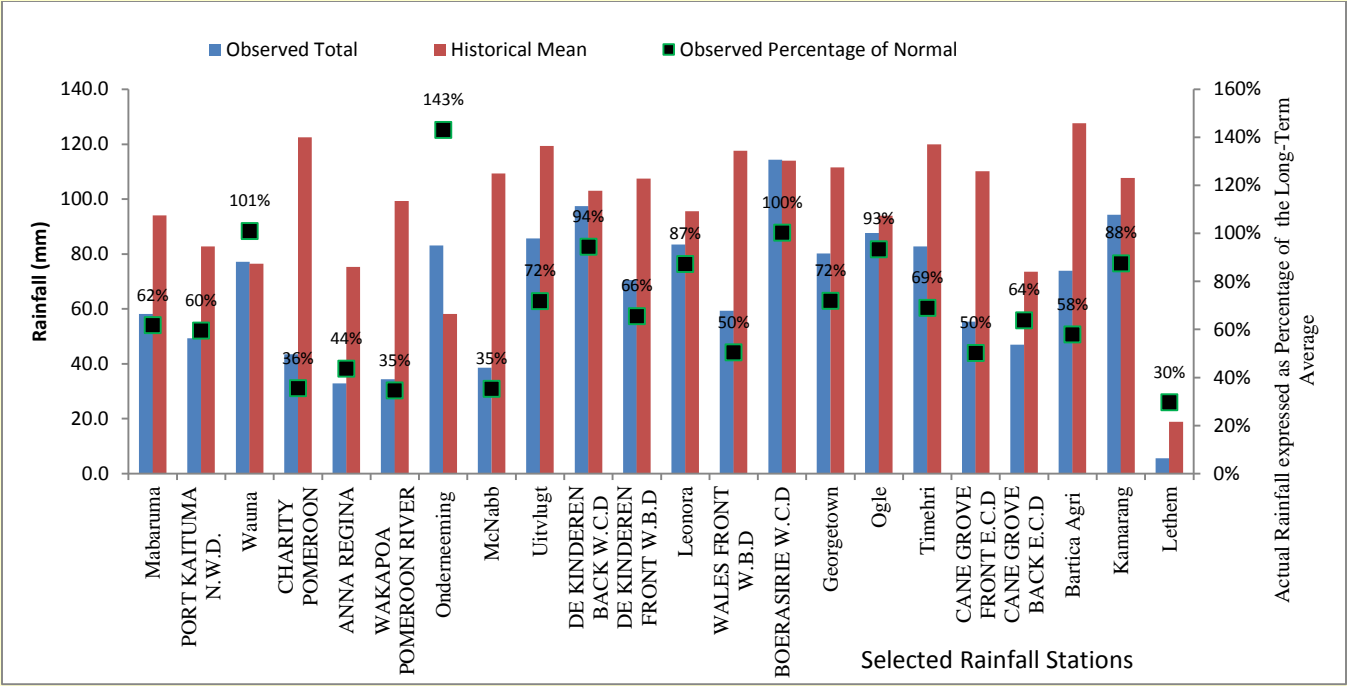


Figure 7 Comparison of the accumulated observed Rainfall for March 2018 expressed as a percentage of the Historical mean

According to the records collected and processed by the Hydromet Service, most locations recorded rainfall amounts significantly less than their historical averages. Region 9 at Lethem recorded the largest deviation from its historical average – a deficit of more than 70% of the historical average at an observed total rainfall of merely 5.6 mm for the entire month, notwithstanding this location does not normally record large monthly rainfall monthly rainfall accumulation during this period. In addition, several locations in Regions 2 and 3 along the Essequibo Coast and West Coast of Demerara also recorded tremendous reduction in the observed rainfall amounts for the month. Both Wakapoa and Mc Nabb recorded a deficit of 65 % in the observed rainfall as compared to the historical average, with rainfall amounts of 34.4 mm and 38.6 mm respectively. Details of the temporal distribution of daily rainfall for several locations are shown in Figure 8 to the left.

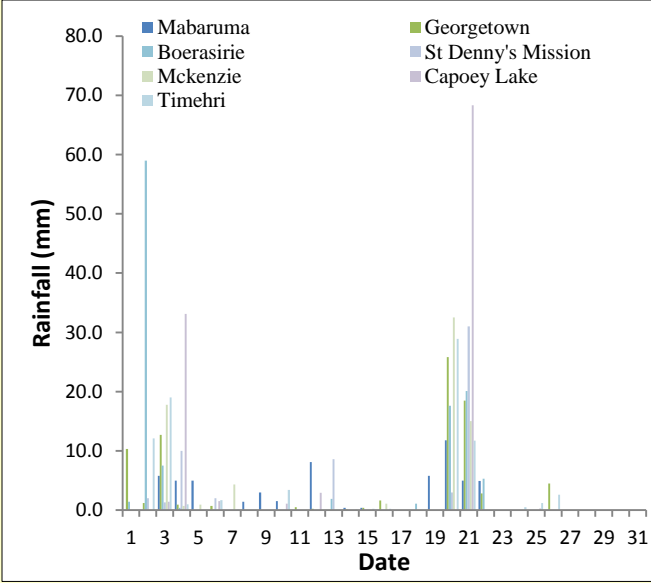


Figure 8 Temporal distribution of daily rainfall for March 2018 for selected stations throughout Guyana

Further analysis of the rainfall amount in Figure 7 above was done and the results presented in Figure

9 below as a histogram. The horizontal axis shows January 2018 accumulated rainfall expressed as a Percentage difference of the long-term average, with -ve values indicating rainfall amounts below the historical averages, while +ve values represent rainfall amounts greater than the historical average. Most notable observations made are that all rainfall stations recorded rainfall amounts significantly

less than their Historical average. Additionally, the histogram shows that more than 95 % of the locations across Guyana recorded rainfall amounts below their historical averages. Further it can be seen that more than a third of the locations had a rainfall deficit in excess of 50%, that is, more than one third of the stations recorded rainfall amounts less than 50% of the historical average.

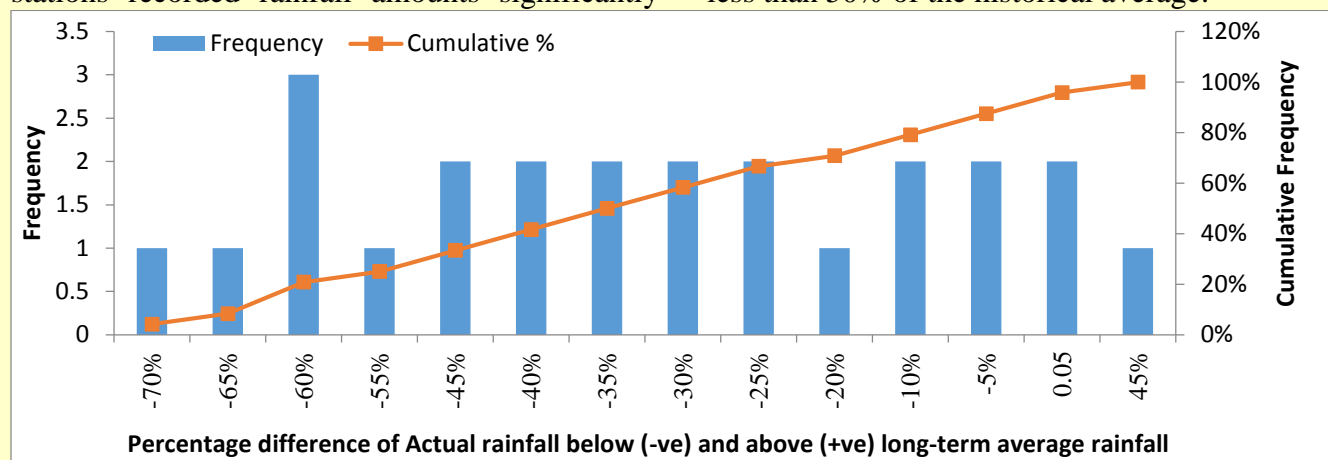


Figure 9 Histogram of March 2018 rainfall as percentage difference of Long term average rainfall

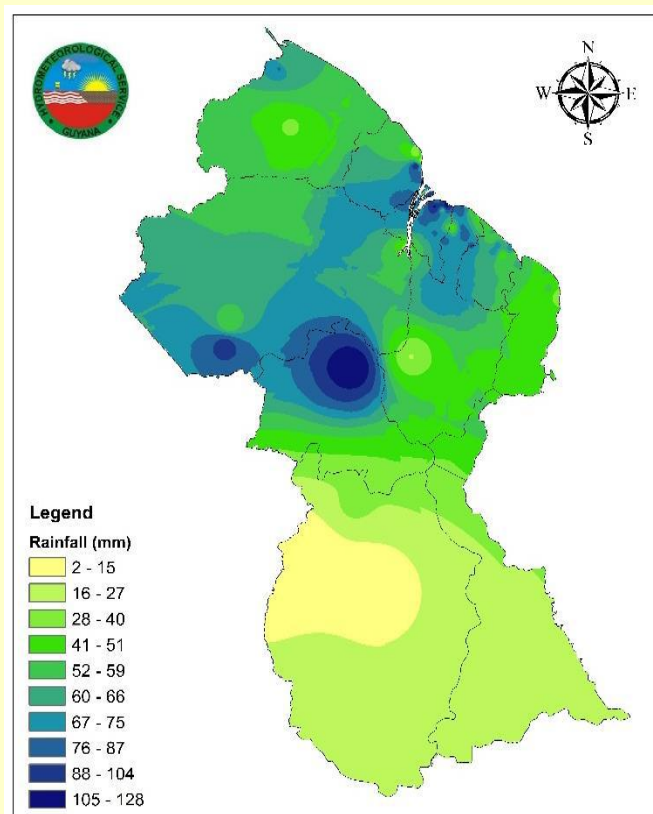


Figure 10 shows a spatial representation of the rainfall distribution across Guyana. Region 10 at Mckenzie recorded the highest accumulated rainfall for March 2018 at 128.1 mm over 15 rain days, while Region 2 at Capoey Lake recorded the highest one – day amount for the month at 68.3 mm on March 21, 2018 (see Figure 8 above). Table 1 below shows classification of rainfall by administrative regions across Guyana.

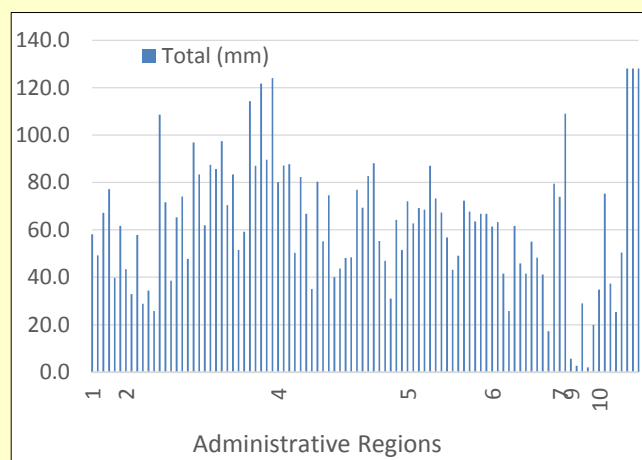


Figure 10 (a)Map and (b) Graph showing Spatial Interpolation (IDW) and distribution of rainfall amounts acrosss Guyana.

Table 1 Classification of Regional rainfall throughout Guyana for March 2018.

<i>Region</i>	Average Rainfall (mm)	Average Rain days	Classification	Station with the highest total
1	56.9	8	Very Dry (VD)	Wauna recorded 77.2 mm in 9 rain days.
2	57.8	6	Very Dry (VD)	Capoey Lake recorded 108.8 mm in 6 rain days.
3	84.6	8	Dry (D)	Parika recorded 124.0 mm in 12 rain days
4	63.3	8	Dry (D)	Ogle recorded 87.7 mm in 10 rain days.
5	63.1	8	Dry (D)	Novar Mahaicony recorded 87.0 mm in 9 rain days.
6	48.7	5	Very Dry (VD)	Crabwood Creek recorded 79.5 mm in 5 rain days.
7	63.4	7	Dry (D)	Dagg Point recorded 109.0 mm in 8 rain days.
8	Mahdia recorded 128.1 mm in 14 rain days- Moderately Dry (MD)			
9	10.2	2	Very Dry (VD)	Annai Rupununi recorded 29.0 in 3 rain days.
10	65.6	7	Dry (D)	Coomaka recorded 95.4 in 7 rain days.

Climatological Summary for March 2018

Table 2 Summary of Observed data and Historical averages for Synoptic stations across Guyan during March 2018

STATION	RAINFALL (mm)		MAX. TEMP (°C)		MIN. TEMP (°C)		SUNSHINE HOURS	
	TOTAL	LONG TERM AVERAGE	MEAN	LONG TERM AVERAGE	MEAN	LONG TERM AVERAGE	MEAN	LONG TERM AVERAGE
<i>MABARUMA</i>	58.1	94.1	30.9	29.8	22.2	21.8	*	5.7
<i>GEORGETOWN</i>	80.2	111.6	29.9	29.6	24.7	24.2	8.4	7.1
<i>TIMEHRI</i>	82.7	119.9	31.8	30.5	19.2	21.4	7.5	4.6
<i>OGLE</i>	87.7	93.9	29.7	*	24.6	*	8.3	*
<i>N/AMSTERDAM</i>	63.6	96.1	30.8	*	23.7	*	7.4	*
<i>LETHEM</i>	5.6	18.9	34.3	32.9	23.1	22.8	8.1	7.0
<i>KAMARANG</i>	94.3	96.0	30.0	28.1	19.7	19.3	6.1	4.6
<i>EBINI</i>	34.8	93.7	32.4	32	21.3	21.9	6.6	5.1

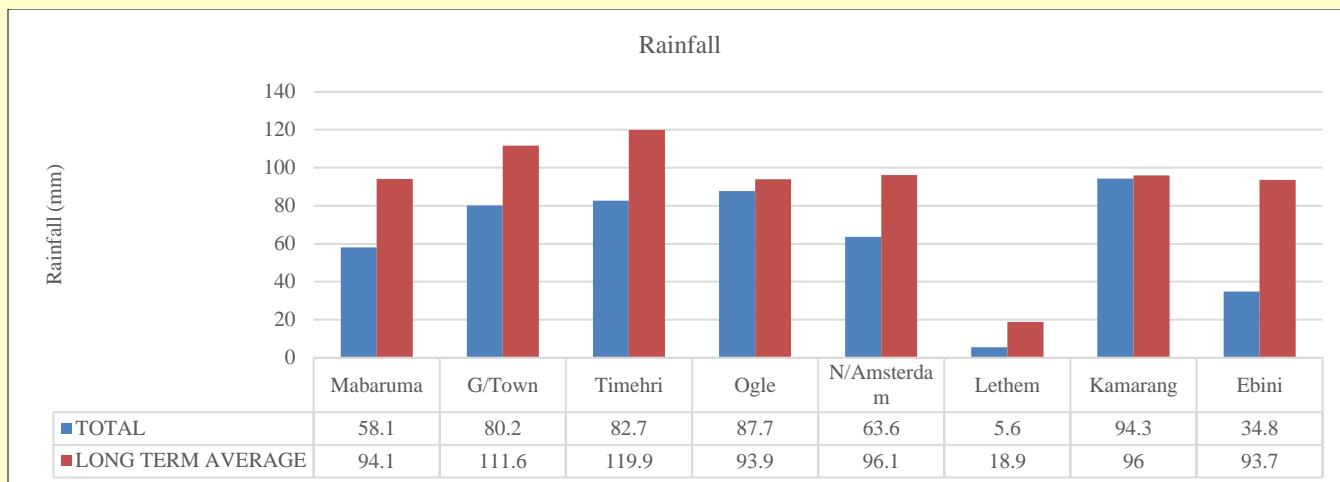


Figure 11 Comparison of March observed rainfall with its historical average for Synoptic Weather Stations across Guyana.

Figure 11 shows a comparison of March 2018 actual accumulated rainfall with the historical average for the Synoptic weather stations across Guyana. With the exception of Region 7 at Kamarang, all synoptic stations across Guyana

recorded rainfall amounts significantly below their long-term averages. Region 10 at Ebini experienced the largest deficit in its March 2018 accumulate rainfall as compared to its historical average for the month.

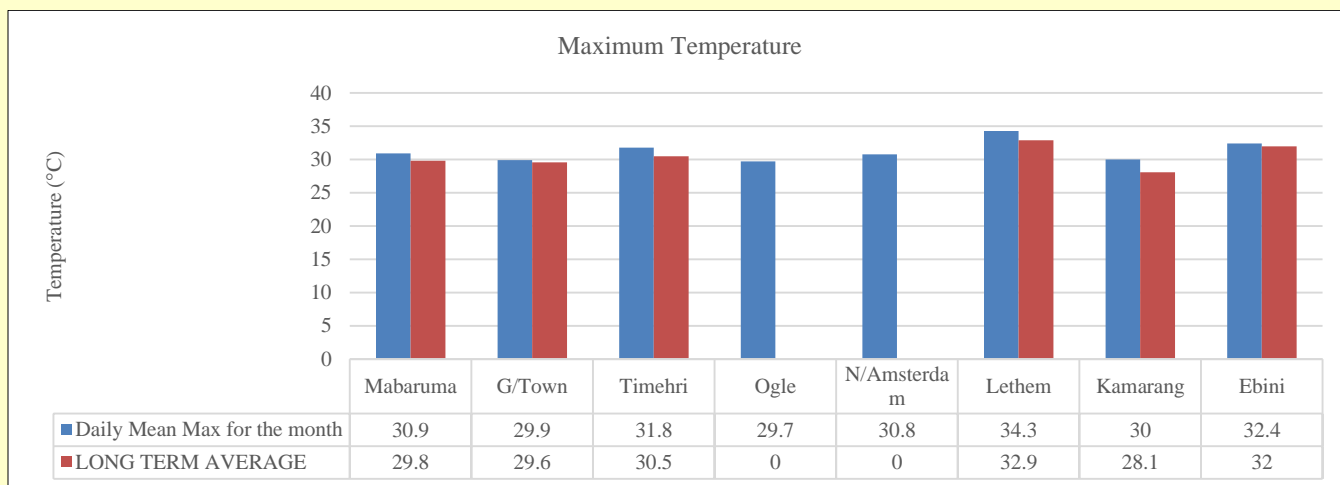


Figure 12 Comparison of March 2018 actual mean monthly Maximum Temperature with mean monthly historical average for March for Synoptic Weather Stations across Guyana

As with the previous few months, during March 2018 all Synoptic stations recorded maximum and minimum temperatures consistent with their long-term averages (correlation factor of more than 0.9) – with only minor variation. Similarly, again as with previous months, according to the data available, all station with available historical averages recorded mean maximum temperatures slightly above their long term averages. For the

minimum temperatures, only Region 4 at Timehri recorded mean minimum temperature with noticeable variation from its long term average. The highest mean maximum temperature of 34.3 °C was recorded in Region 9 at Lethem, as is usually the case (reflected in the historical average). In addition, this station also recorded the highest one-day Max Temperature of 36.0 °C on March 19, 2018. On the other hand, in keeping with

the usual trend across Guyana (long term averages shown in Figure 13), Region 4 at Timehri recorded the lowest minimum temperature of 19.2°C. It is
not surprising that this location also recorded the lowest one – day minimum temperature of 16.4°C also on March 19, 2018.

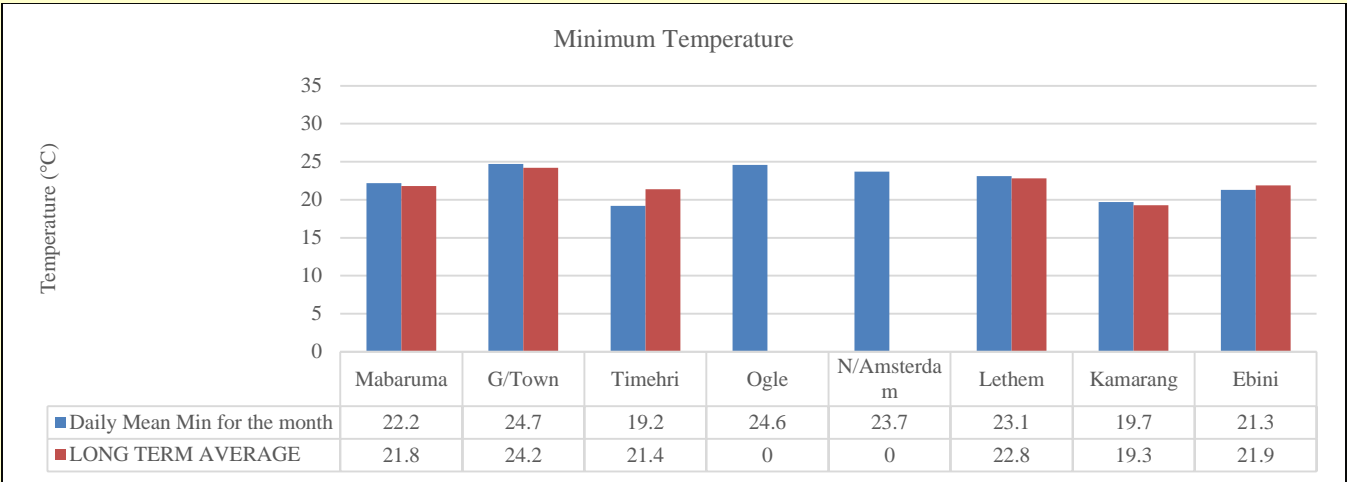


Figure 13 Comparison of March 2018 actual mean monthly Minimum Temperature with mean monthly historical average for March for Synoptic Weather Stations across Guyana

According to the available data, all station (with available historical records) recorded mean daily bright sunshine hours above their long term averages. As is usually the case according to the historocal record, Region 4 at Georgetown recorded the highest mean daily Bright Sunshine Hours of 8.4 hours/day for March 2018 with Ogle,
trailing by only 0.3 hours/day as the second highest. It is worthwhile to note that the observed mean daily value for Timehri exceeded the historical average by more than 60%. Not surprisingly, Region 4 at Georgetown also recorded the maximum one – day Bright Sunshine hour of 11.1 hours on March 01, 2018.

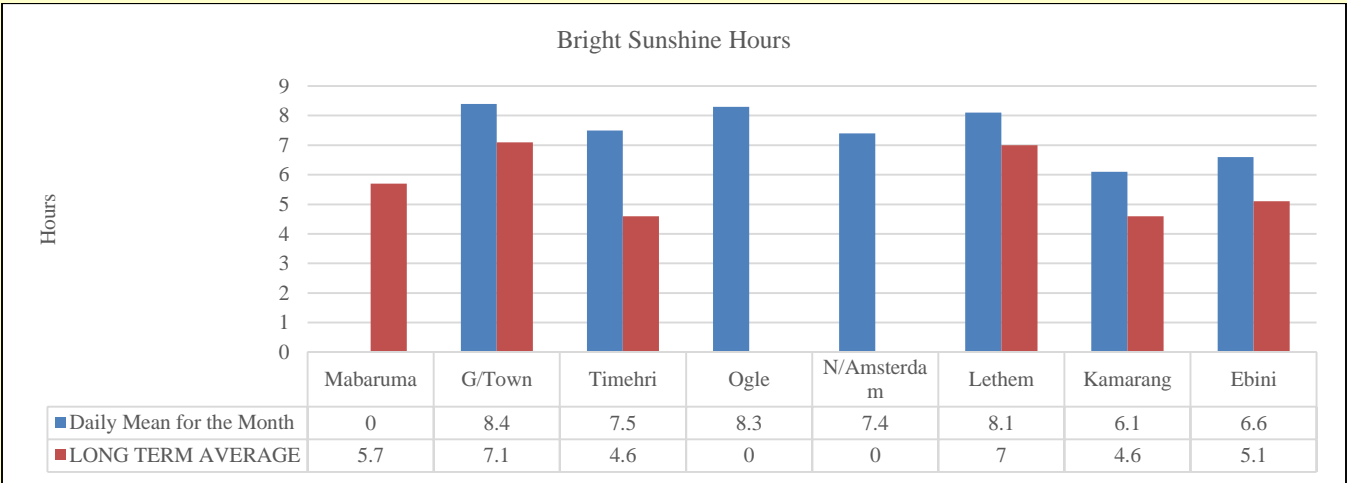


Figure 14 Comparison of March 2018 actual daily mean Bright Sunshine Hours with historical average for March for Synoptic Weather Stations across Guyana

Global Analysis

March 2018 was characterized by warmer-than-average conditions across much of the world's surface. Overall, the combined global land and ocean temperature for March 2018 was 0.83°C (1.49°F) above the 20th century average of 12.7°C (54.9°F) and the fifth highest March temperature departure from average in the 139-year record. This value was also 0.40°C (0.72°F) cooler than the record high set in 2016 and was the smallest temperature departure from average in the last four

years, with March 2015–17 being the three warmest Marches on record. March 2018 also marks the 42nd consecutive March and the 399th consecutive month with temperatures, at least nominally, above the 20th century average. March 2018 also had the highest monthly temperature departure from average since July 2017. The March global land and ocean surface temperature has increased 0.08°C (0.14°F) per decade since 1880. That rate is more than double since 1980.

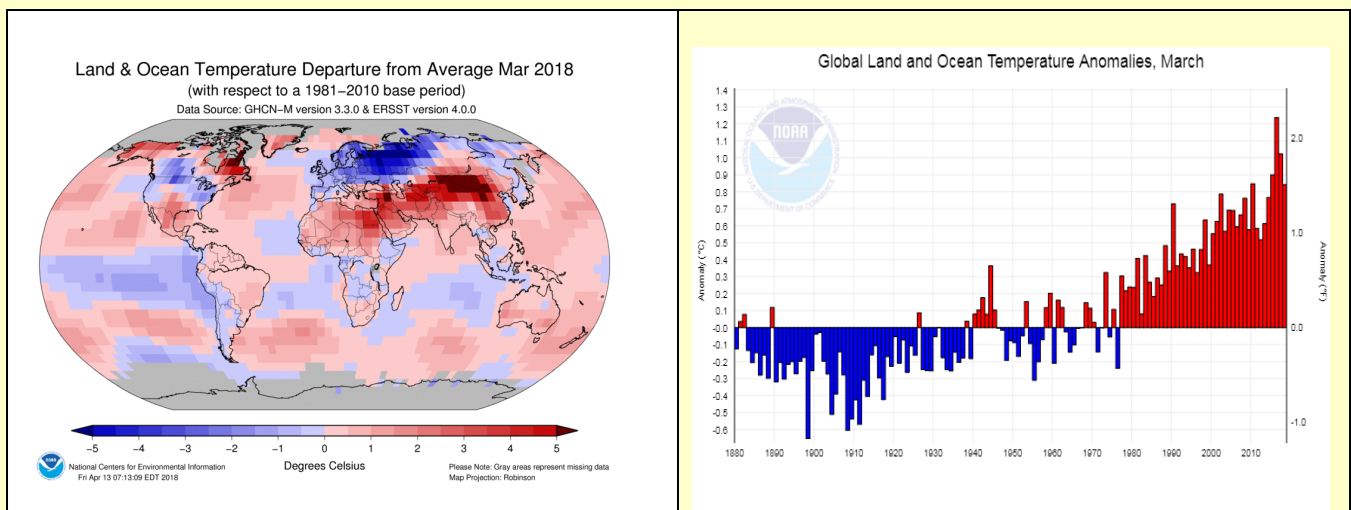


Figure 15(a) Global departure of March 2018 Land and Ocean Temperatures from the Historical averages taken for period 1981 - 2010. Compliments of NOAA³. (b) Global Land and Ocean Temperature Anomalies for the month of March from 1880 to 2018⁴

The global land surface temperature for March 2018 was 1.49°C (2.68°F) above average and the seventh highest since global records began in 1880. The January–March 2018 global land surface temperature was also the smallest in the last four years and the sixth highest in the 139-year record at 1.21°C (2.18°F) above the 20th century average.

The global oceans ranked as the fifth highest on record at 0.58°C (1.04°F) above average. The global ocean temperature for the first three months of the year was also the smallest since 2014 and the fifth highest on record at 0.56°C (1.01°F) above average.

³ <http://www.ncdc.noaa.gov/sotc/service/global/map-blended-mntp/201803.gif>

⁴ http://www.ncdc.noaa.gov/cag/time-series/global/globe/land_ocean/1/3/1880-2018

Climatological Outlook for the next few Weeks

CariCOF Precipitation and Temperature Outlook for April to June 2018

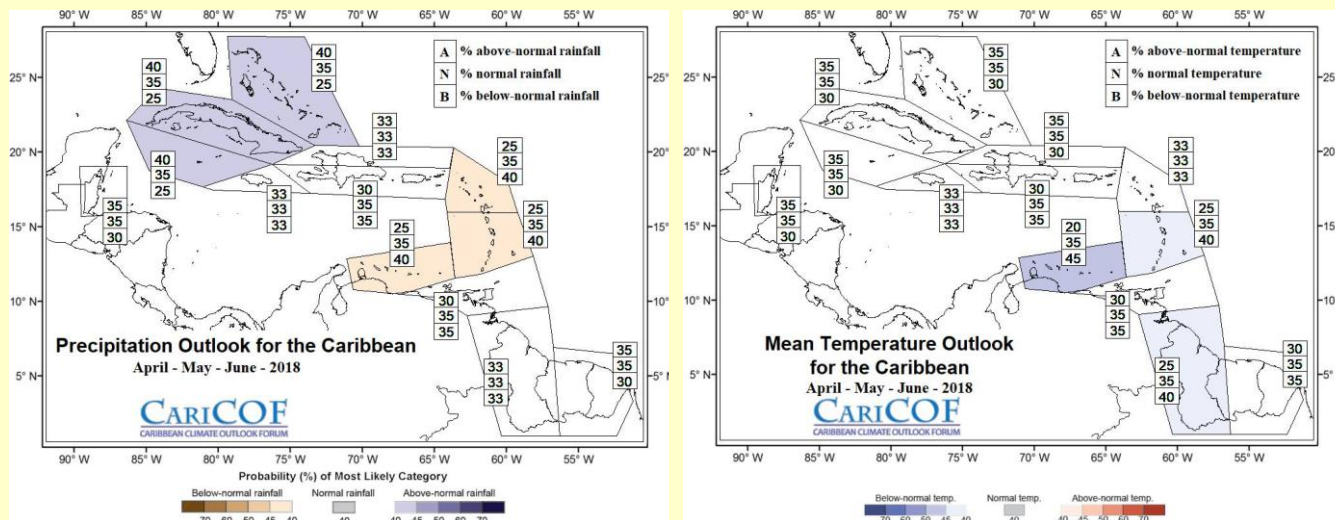


Figure 16 CariCOF (a) Precipitation and (b) Temperature outlook for the Caribbean for the period valid April – June, 2018 showing 80% confidence for *Above Normal to Normal* rainfall and Temperature for Guyana

According to the Outlook provided by CariCOF for the period April – June 2018 in Figure 16(a) above, little can be said at this time, but the chance for extreme wet or dry is very low, however, since this is the transitioning phase from dry to wet season, the chance for extremely wet conditions are a bit higher than usual.

Additionally, according to the Temperature Outlook in Figure 16(b) above, cooler than to pretty much like usual can be expected for this period with a confidence level of 75%. Since this is the period within the wet season, extreme heat (or cold) is not a concern.

CariCOF Wet Days and Wet Spells Outlook for April – June 2018

Table 3 Climatological Normals and Forecasted Number of *Wet Days* and various categories of *Wet Spells* for selected locations across Guyana for the period April – June, 2018

April to June 2018	No. of wet days		No. of 7-day wet spells (20% wettest)		No. of 7-day very wet spells (10% wettest)		No. of 3-day extremely wet spells (1% wettest)	
	Climatology	Forecast	Climatology	Forecast	Climatology	Forecast	Climatology	Forecast
Guyana_73	26-40	25-39	2.8-6.2	2.9-6.7	1.3-3.4	1.1-4.2	0-1	0-2.2
Guyana (Albion)	37-52	37-52	2.7-5.6	2.7-6.1	1.3-3	1.4-3.1	0-2	0-1.9
Guyana (Blairmont)	44-58	41-58	3.1-6.1	3.3-6.5	1.3-3.4	1.3-4.1	0-1.3	0-1.7
Guyana (Charity)	34-53	30-55	2.6-5.4	2.1-6.8	0.9-3	0.7-3.2	0-1	0-0.1
Guyana (Enmore)	42-54	40-54	2.7-5.6	2.8-6.2	1.3-3	1.1-3.3	0-1	0-1.7
Guyana (Georgetown)	45-60	44-58	3-6.4	2.9-5.9	1.4-3.4	1.1-3.4	0-1	0-1.3
Guyana (New Amsterdam)	42-60	40-58	3-6.1	3.2-6.3	1.6-3.8	1.3-3.8	0-2	0-1.6
Guyana (Skeldon)	41-57	40-57	3.2-6.4	3.2-6.7	1.2-3.9	1.1-4.6	0-1	0-1.2
Guyana (Timehri)	49-61	46-62	3-6.4	2.8-6.3	0.9-3.4	1.1-3.5	0-2	0-2.3
Guyana_Wales	46-58	45-59	3.1-6.1	3.1-6.4	1.3-4.3	0.9-3.9	0-1.9	0-2

brown is a decrease in frequency, dark blue an increase, grey none are expected

Wet Days: Usually, during April – May – June, 40 to 55 of the 91 days are Wet Days along Coastal Guyana – shown in Table 3 above. For April – June 2018, the forecast does not indicate any change in the amount of Wet Days across coastal Guyana.

7 – Days Wet Spells: Usually, Coastal Guyana experiences up to 6 ‘Seven – Days’ Wet Spell, with

up to 4 of them being Very Wet for the period April – June. For April – June 2018, the forecast indicates that there will be no shift in the usual number of Wet and Very Wet spells – low confidence (see Table 3 for usual and forecast occurrences).

IRI-ENSO Forecast

Synopsis: La Niña is expected to transition to ENSO-neutral during April-May, with ENSO-neutral then likely (greater than 50% chance) to continue through the Northern Hemisphere summer 2018.

During March 2018, La Niña continued to weaken, but was still reflected by below-average sea surface temperatures (SSTs) across the east-central and eastern equatorial Pacific Ocean. The latest weekly index values were -0.5°C and -0.3°C in the Niño-3.4 and Niño-3 regions, respectively, -1.1°C in the Niño1+2 region, and near zero in the Niño.4 region. While negative anomalies were weakening near the surface, the sub-surface temperature anomalies (averaged across 180° - 100°W) warmed

due to the eastward propagation of a downwelling equatorial oceanic Kelvin wave. Convection was suppressed near and east of the Date Line and enhanced over the far western tropical Pacific Ocean. Low-level wind anomalies were easterly over the east-central Pacific, and westerly over the far western Pacific. At upper-levels, winds were anomalously westerly over the eastern Pacific. Overall, the ocean and atmosphere system remained consistent with a weak La Niña.

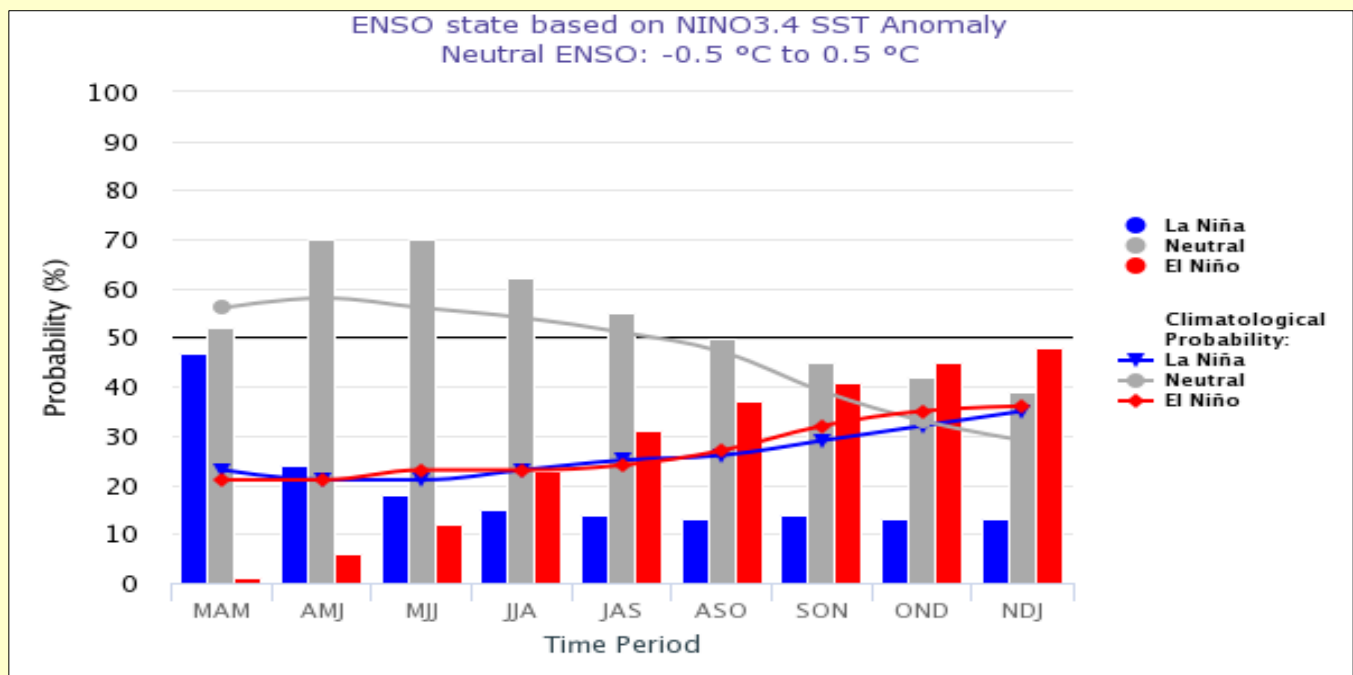


Figure 17 April 2018 CPC/IRI Official Probabilistic ENSO Forecast

Recent and Current Conditions

In mid-April 2018, the NINO3.4 SST anomaly was at the level of warm-neutral to borderline La Niña. For March the SST anomaly was -0.73 C, indicating weak La Niña, and for January-March it was -0.79 C, also in that range. According to the IRI and NOAA/Climate Prediction Center, the condition for El Niño requires that the SST anomaly in the Nino3.4 region (5S-5N; 170W-120W) exceed 0.5 C. Similarly, for La Niña, the anomaly must be -0.5 C or less. The climatological probabilities for La Niña, neutral, and El Niño conditions vary seasonally, and are shown in a table in Annex IV for each 3-month season. The most recent weekly anomaly in the Nino3.4 region was -0.4, showing warm-neutral conditions.

Expected Conditions

The official diagnosis and outlook produced jointly by CPC and IRI issued by the NOAA/Climate Prediction Center ENSO Diagnostic Discussion stated that La Niña is likely to transition to ENSO-neutral during the March-May season. As of mid-

However, the pertinent atmospheric variables, including the lower level zonal wind anomalies, the Southern Oscillation Index and the anomalies of outgoing longwave radiation (convection), continue showing patterns suggestive of La Niña. On the other hand, subsurface temperature anomalies across the eastern equatorial Pacific have warmed to moderately above-average, suggesting that the dissipation of the La Niña is imminent, if not occurring right now. Given the current and recent SST anomalies, the subsurface profile and the conditions of most key atmospheric variables, it appears we are currently in transition from weak La Niña to neutral, ending the weak-to-moderate La Niña of 2017-18.

March, more than 90% of the dynamical or statistical models predict neutral conditions for the initial Apr-Jun 2018 season, with less than 10% showing a continuation of La Niña conditions – see Table 4 below for probability of occurrence.

Table 4 Showing IRI/CPC Mid – April model Based Forecast probabilities for La Niña, neutral, and El Niño conditions for each 3-month season.

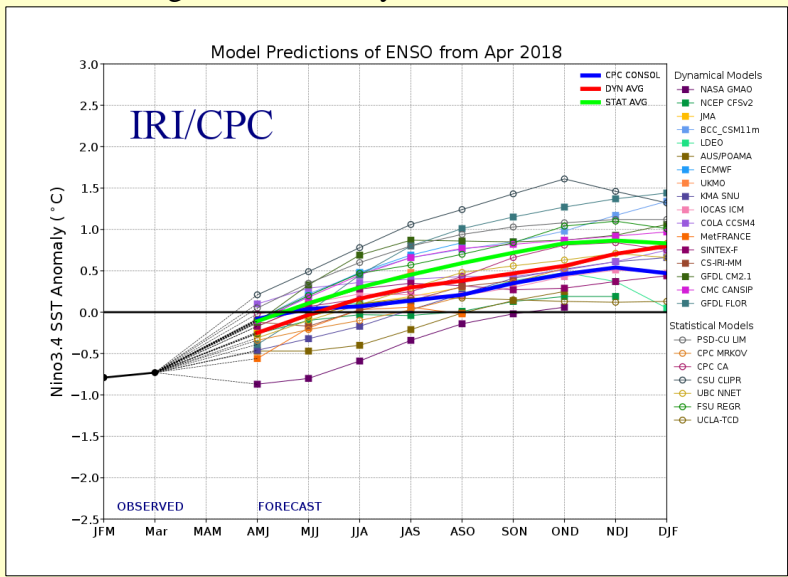


Figure 18 April 2018 Plume of Model ENSO Predictions

In summary, the probabilities derived from the models on the IRI/CPC plume describe, on average, a strong preference for ENSO-neutral from Apr-Jun to Jun-Aug 2018, approximately equal probabilities for neutral or El Niño

conditions for Aug-Oct, followed by a period from Sep-Nov through Dec-Feb 2018-19 when El Niño conditions are between approximately 55% and 65% likely. Probabilities for La Niña are roughly 10% throughout the entire forecast period.

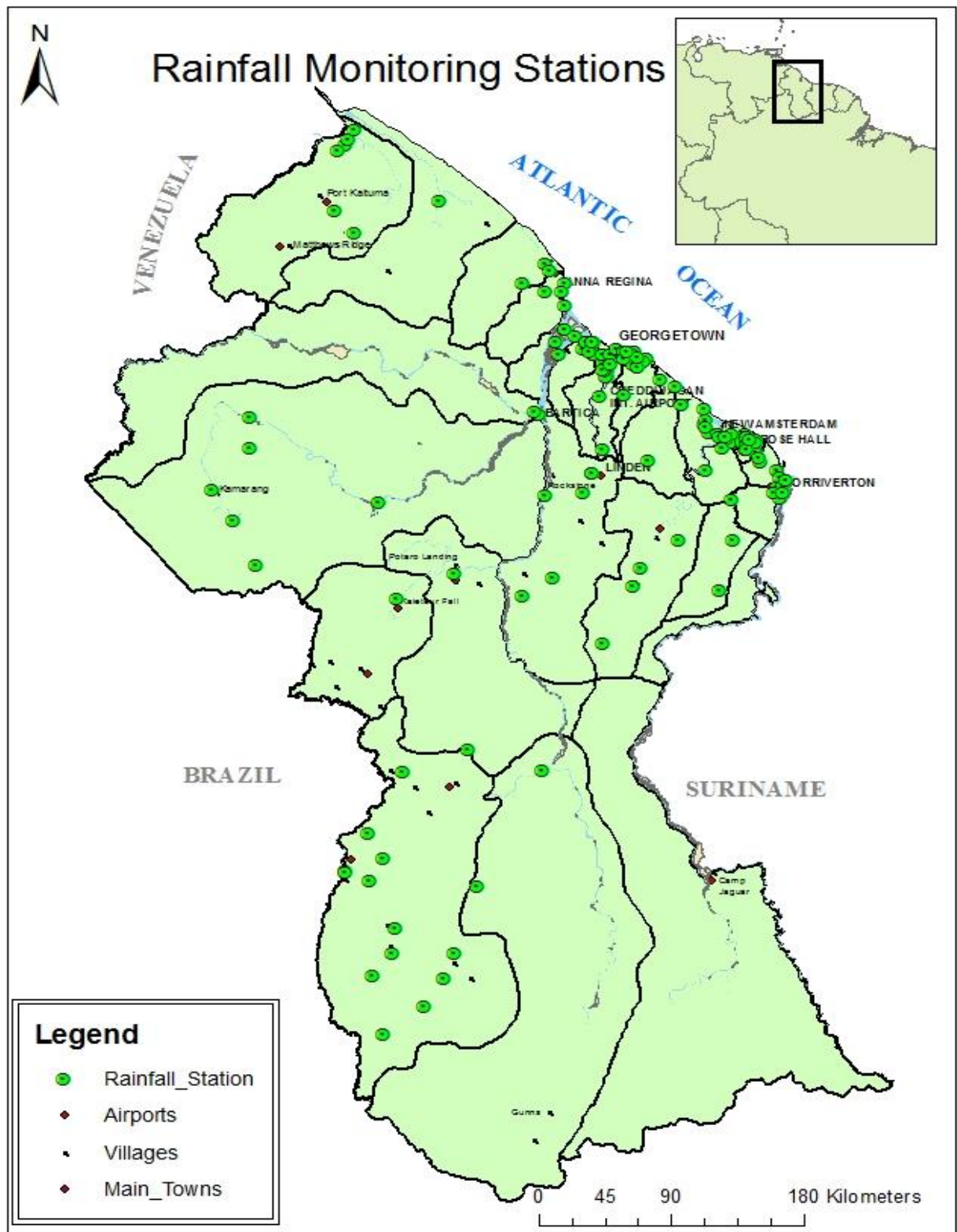
Season	La Niña	Neutral	El Niño
MAM2018	47%	52%	1%
AMJ 2018	24%	70%	6%
MJJ 2018	18%	70%	12%
JJA 2018	15%	62%	23%
JAS 2018	14%	55%	31%
ASO 2018	13%	50%	37%
SON 2018	14%	45%	41%
OND 2018	13%	42%	45%
NDJ 2019	13%	39%	48%

Annex I

Glossary of Terms

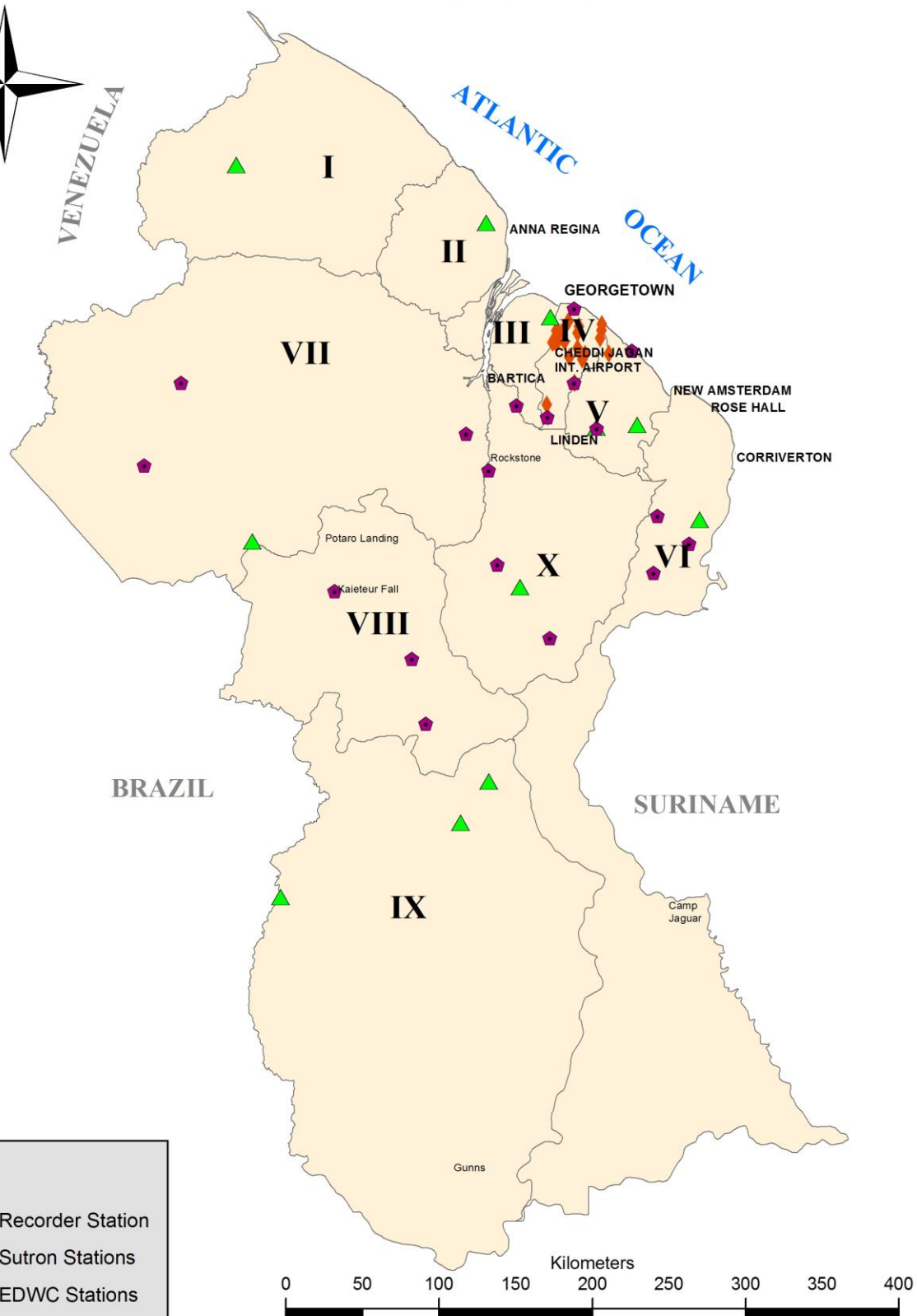
- **CariCOF** - Caribbean Climate Outlook Forum
- **CPC** – Climate Prediction Center
- **ENSO** - *El Niño–Southern Oscillation* is an irregularly periodical variation in winds and sea surface temperatures over the tropical eastern Pacific Ocean, affecting much of the tropics and subtropics.
- **Historical Mean** - Arithmetical mean computed using all the available Historical data from time of commencement of data collection.
- **IRI** – International Research Institute
- **ITCZ** - *The Inter Tropical Convergence Zone* is a belt of low pressure which circles the Earth generally near the equator where the trade winds of the Northern and Southern Hemispheres come together.
- **Long Term Average** - Same as Historical Mean
- **NOAA** - National Oceanic and Atmospheric Administration
- **Normal** - An Arithmetical mean taken over a Thirty (30) years period defined by WMO - currently 1981-2010.
- **OLR** – Outgoing Longwave Radiation.
- **Primary Dry Season** - The Major Dry Season in Guyana Occurring during the period August to mid-November
- **Primary Wet Season** - A period of heavy rainfall in Guyana occurring during the period Mid-April to Mid-July as a result of the northward movement of the ITCZ
- **Secondary Dry Season**
- **Secondary Wet Season** - A rainfall season in Guyana occurring during the period mid-November to January as a result of the Southward movement of the ITCZ
- **SST** - Sea Surface Temperature
- **WMO** - World Meteorological Organization

Annex II





Administrative Distribution of Hydrological Stations



Annex III**Classification of Precipitation Values**

DESCRIPTION	ABBREVIATION	RAINDAYS	RAINFALL (mm)
Very Dry	VD	0-10 11-20	0-59.9 11-29.9
Dry	D	1-10 11-20 21-31	60-119.9 30-89.9 21-59.9
Moderately Dry	MD	1-10 11-20 21-31	120-179.9 90-149.9 60-119.9
Moderately Wet	MW	1-10 11-20 21-31	180-239.9 150-209.9 120-179.9
Wet	W	1-10 11-20 21-31	240-329.9 210-269.9 180-239.9
Very Wet	VW	1-10 11-20 21-31	330-449.9 270-389.9 240-329.9
Exceedingly Wet	EeW	1-10 11-20 21-31	450-569.9 390-509.9 330-449.9
Excessively Wet	EsW	1-10 11-20 21-31	>570 510-629.9 450-569.9
Extremely Wet	EtW	11-20 21-31	>630 >570

Table Showing variation in seasonal climatological probabilities for La Niña, neutral, and El Niño conditions for each 3-month season

SEASON	LA NIÑA	NEUTRAL	EL NIÑO
DJF	36%	30%	34%
JFM	34%	38%	28%
FMA	28%	49%	23%
MAM	23%	56%	21%
AMJ	21%	58%	21%
MJJ	21%	56%	23%
JJA	23%	54%	23%
JAS	25%	51%	24%
ASO	26%	47%	27%
SON	29%	39%	32%
OND	32%	33%	35%
NDJ	35%	29%	36%

Sources

- <http://carogen.cimh.edu.bb/index.php/component/countrydata/countrydata?dataset=rainfall>
- http://iri.columbia.edu/our-expertise/climate/forecasts/enso/current/?enso_tab=enso-cpc_update
- NOAA National Centers for Environmental information, Climate at a Glance: Global Time Series. <http://www.ncdc.noaa.gov/cag/>
- NOAA National Centers for Environmental Information, State of the Climate: Global Climate Report for March 2018, retrieved from: <https://www.ncdc.noaa.gov/sotc/global/201803>.
- http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.html
- <http://www.ncdc.noaa.gov/sotc/global/201803>
- <http://iri.columbia.edu/wp-content/uploads/2018/03/figure1.gif>

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