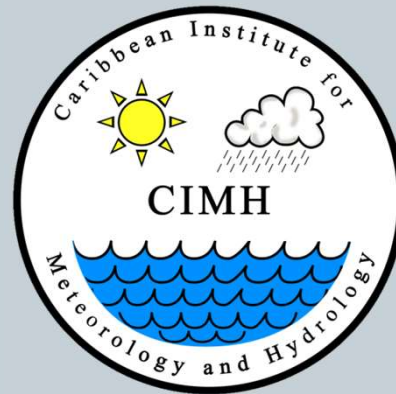


Caribbean Climate Outlook Forum drought forecasts: successes in providing actionable drought early warning for Small Island Developing States

Dr. Cedric J. VAN MEERBEECK – Climatologist (cmeerbeeck@cimh.edu.bb)

Caribbean Institute for Meteorology and Hydrology (CIMH)

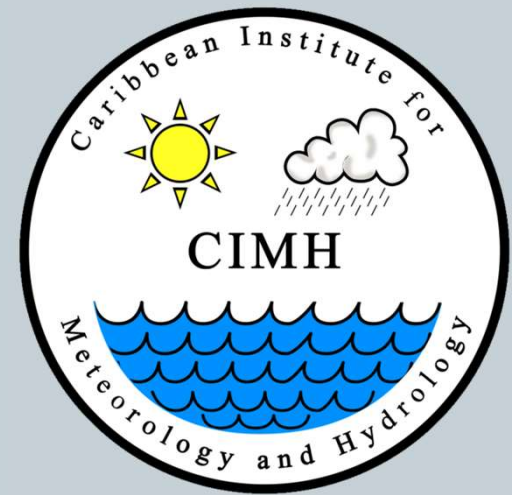


<http://rcc.cimh.edu.bb>

IDMP Webinar on Drought Monitoring and Forecasting
17 June, 2021

Functions of the Caribbean Institute for Meteorology & Hydrology

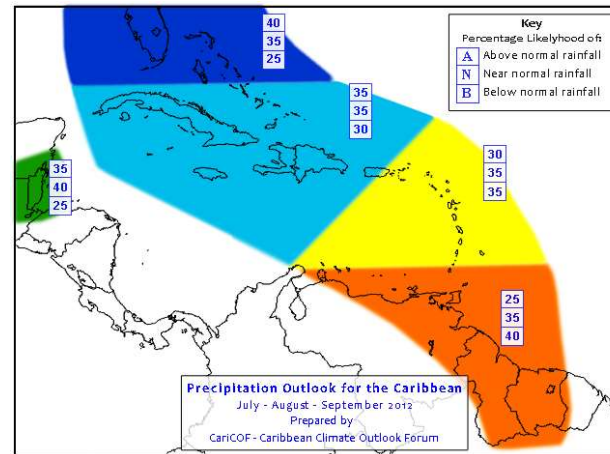
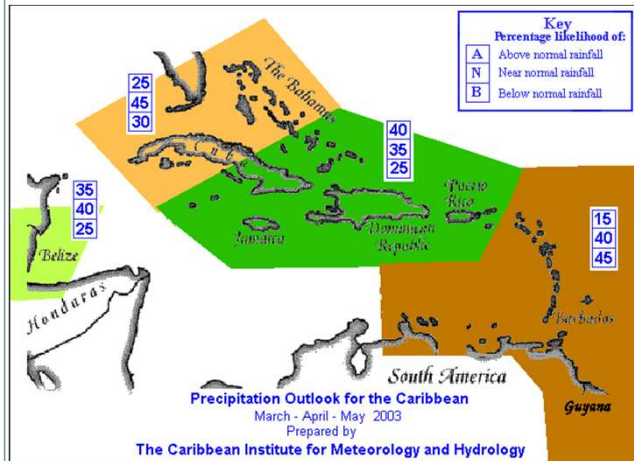
- **WMO Regional Training Centre** - Train various categories of meteorological and hydrological personnel
- Operate as a **centre of research** in meteorology, hydrology and associated sciences
- **Regional Climate Data Centre** - Data collection, storage, & dissemination
- **Regional Instrument Centre** – Develop, maintain, repair, and calibrate meteorological & hydrological instruments
- **Regional Centre of Excellence for Training in Satellite Meteorology**
- **WMO Regional Climate Centre** (Designated in May 2017)
- **Caribbean Centre for Climate and Environmental Simulations**



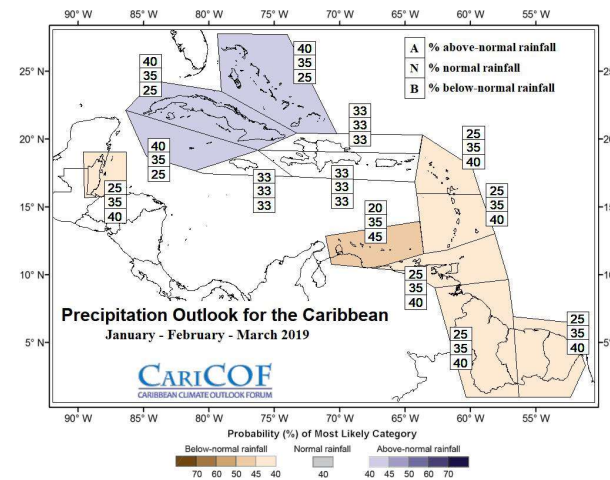
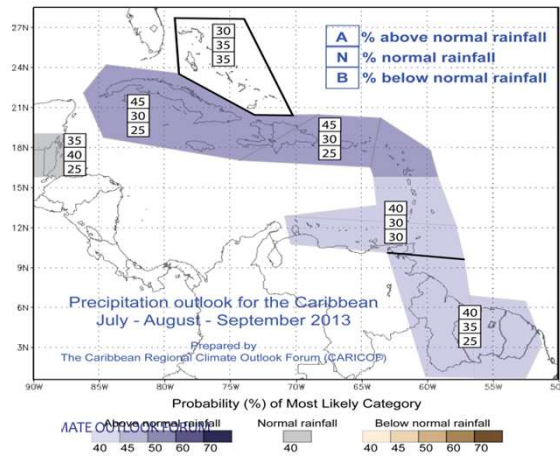
- **WMO Pan American Centre for Sand & Dust Storm Warning Alerting & Advisory System;**
- **Advisor to regional governments** on matters related to meteorology, climate & hydrology
- Provide **specialized services** to industry

Actionable drought forecasts

Problem definition



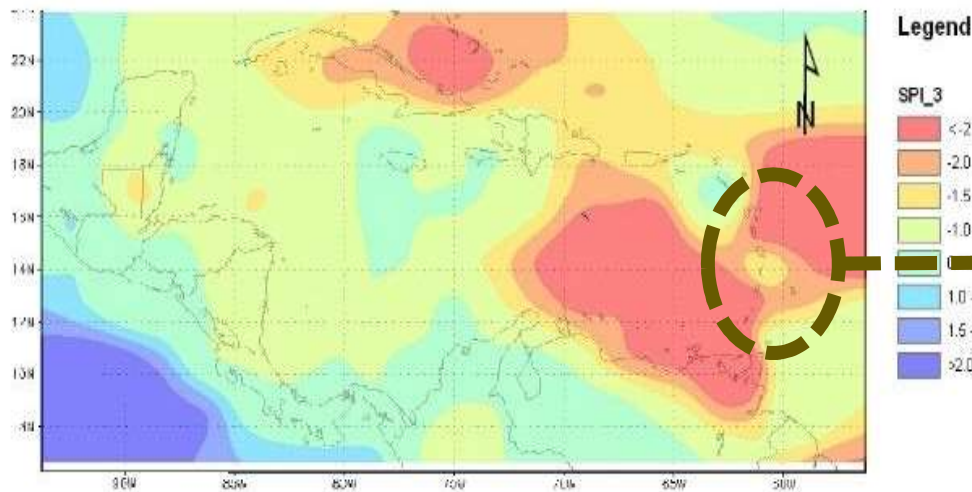
Seasonal rainfall forecasts since 1998 (CIMH / CariCOF) in the drought-prone Small Island Developing States (SIDS) region of the Caribbean



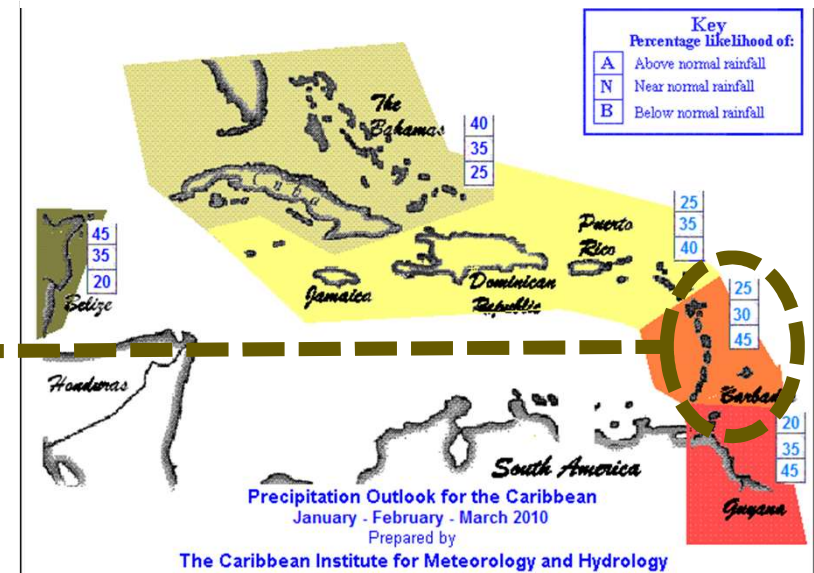
Actionable drought forecasts

Problem definition

SPI map for
Jan. – Feb. – Mar. 2010



Seasonal rainfall forecast
Jan. – Feb. – Mar. 2010



Forecast: 45% chance of below-normal rainfall for Barbados during Jan.-Feb.-Mar. 2010.

Value: At times, the seasonal rainfall forecast can provide **some level of early detection** of drought risk.

Barrier: **The information** provided in the forecast is **not perceived as actionable** for drought risk reduction.

Problem: **Limited relevance** (terciles \neq drought thresholds), **low confidence** & **inadequate language**.

Actionable drought forecasts

Essential attributes

- What kind of drought forecast information best informs **Drought Early Warning**?
 - **Actionable** = effectively **informing preparedness and response actions**
meaning:
 - **Confident** = **high probabilities** enable effective sectoral resources allocation
 - **Good** = forecast **correctly detects** impending hazards
 - **Timely** = **sufficient lead time** for preparedness and response actions
 - **Understandable** = utilising a common **language/jargon**
 - **Relevant** = relates to an **outcome of direct interest** to the user
 - **Sustainable** = **continuity** of operations despite understaffing & underfunding
 - **Authoritative** = forecast **information source** perceived as **trustworthy** by the user
 - **Contextualised** = monitoring, forecast and impact info **packaged** into a bulletin

Actionable drought forecasts

Solutions – increasing confidence by adding persistence

Adding persistence
uncertain
(i.e. observations)

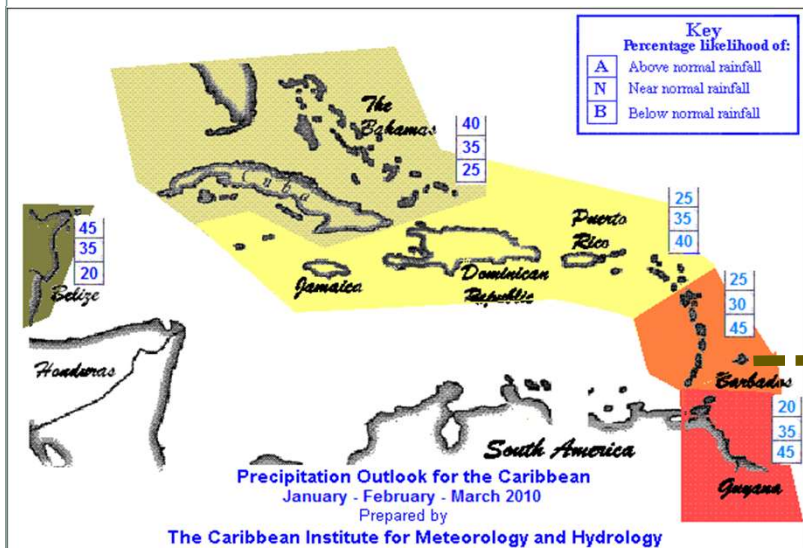
=

adding certainty to an

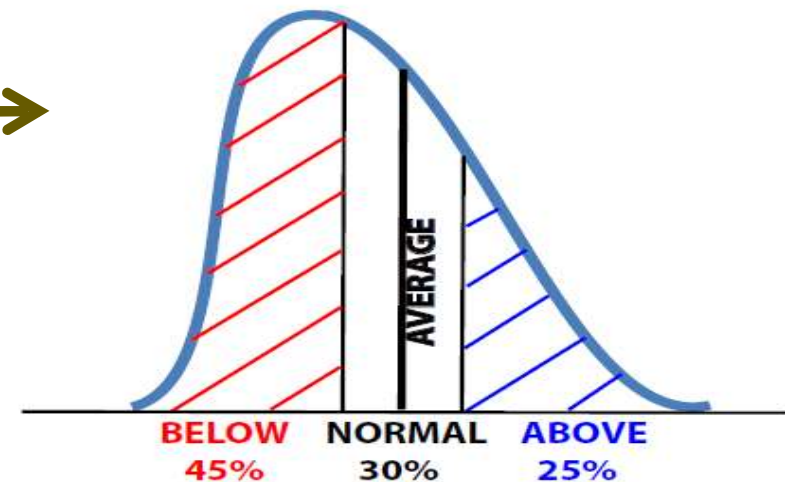
forecast of slow onset events
such as drought

Actionable drought forecasts

Solutions – increasing confidence by adding persistence



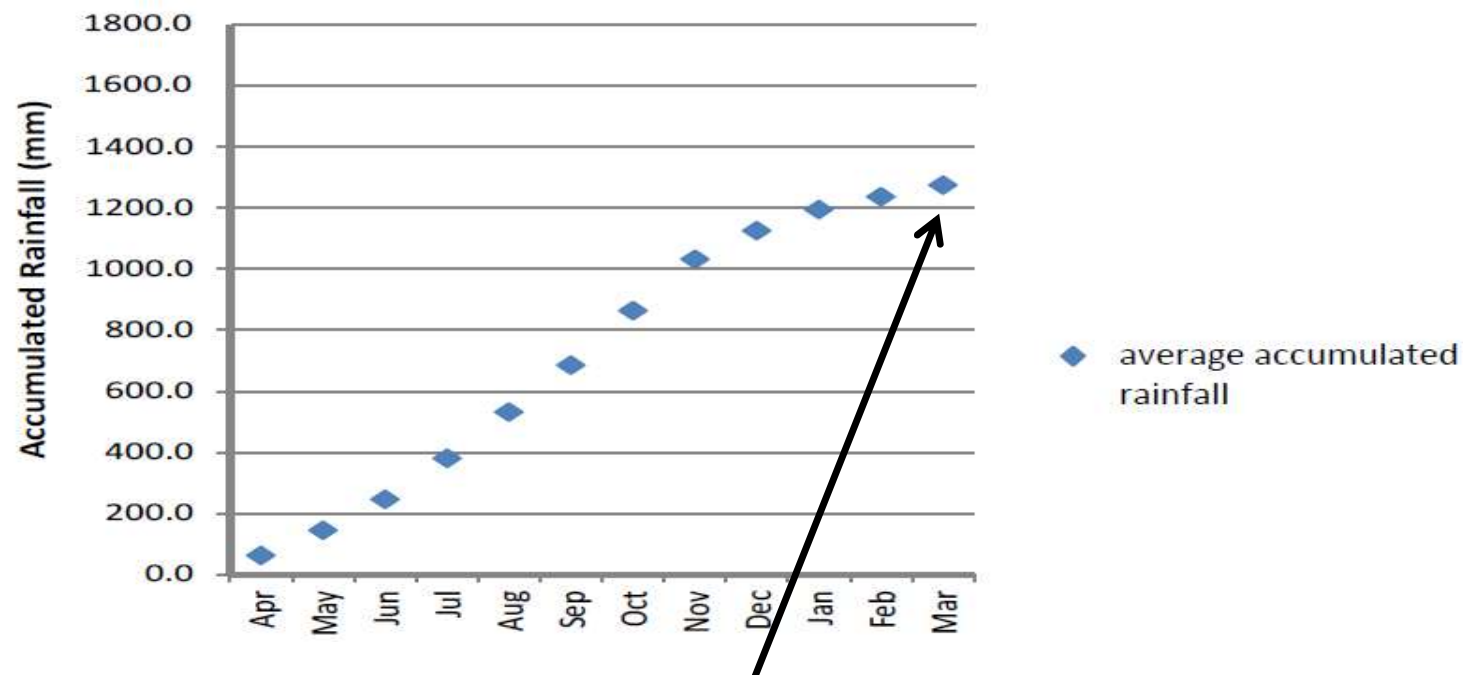
**CIMH seasonal forecast for Barbados for
January-February-March 2010**
(A = 25%, N = 30%, B = 45%)



HOW MUCH RAINFALL WE EXPECTED IN JFM

Actionable drought forecasts

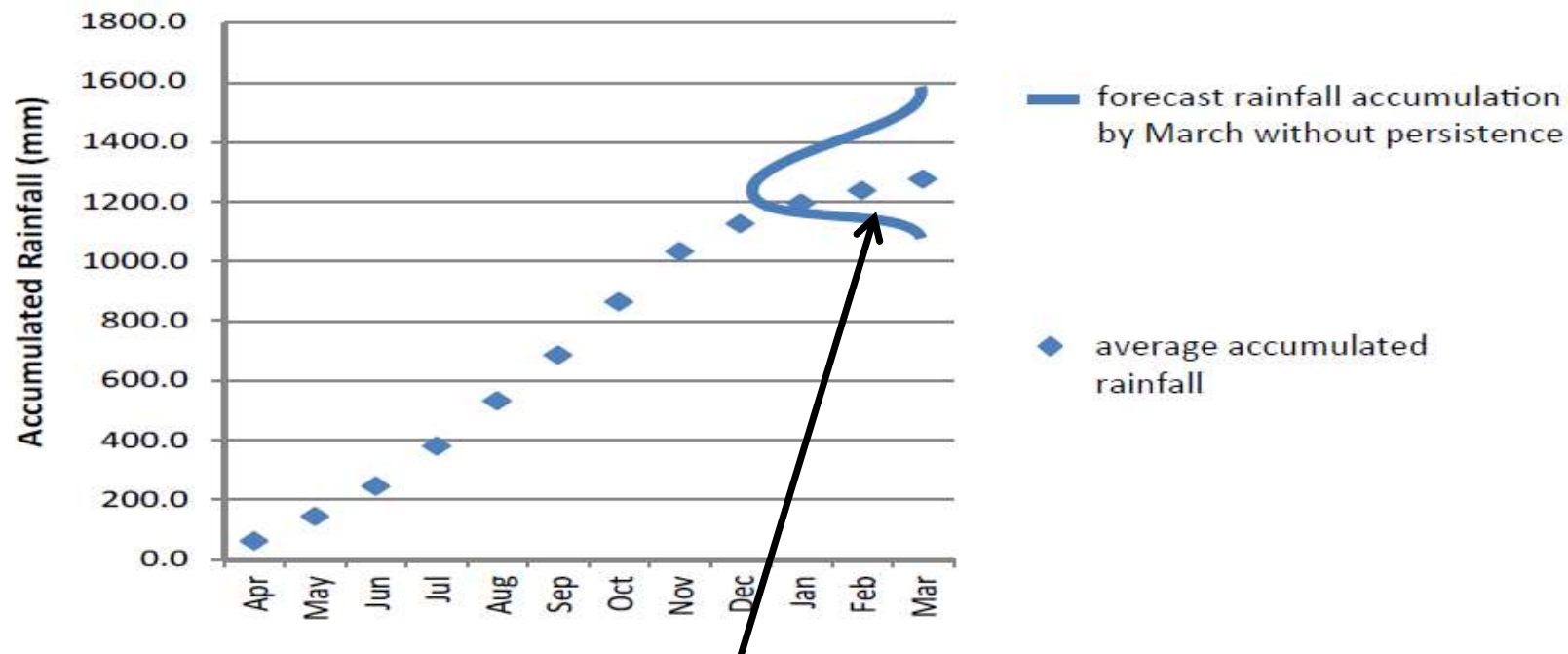
Solutions – increasing confidence by adding persistence



HOW MUCH RAINFALL WE NORMALLY EXPECT

Actionable drought forecasts

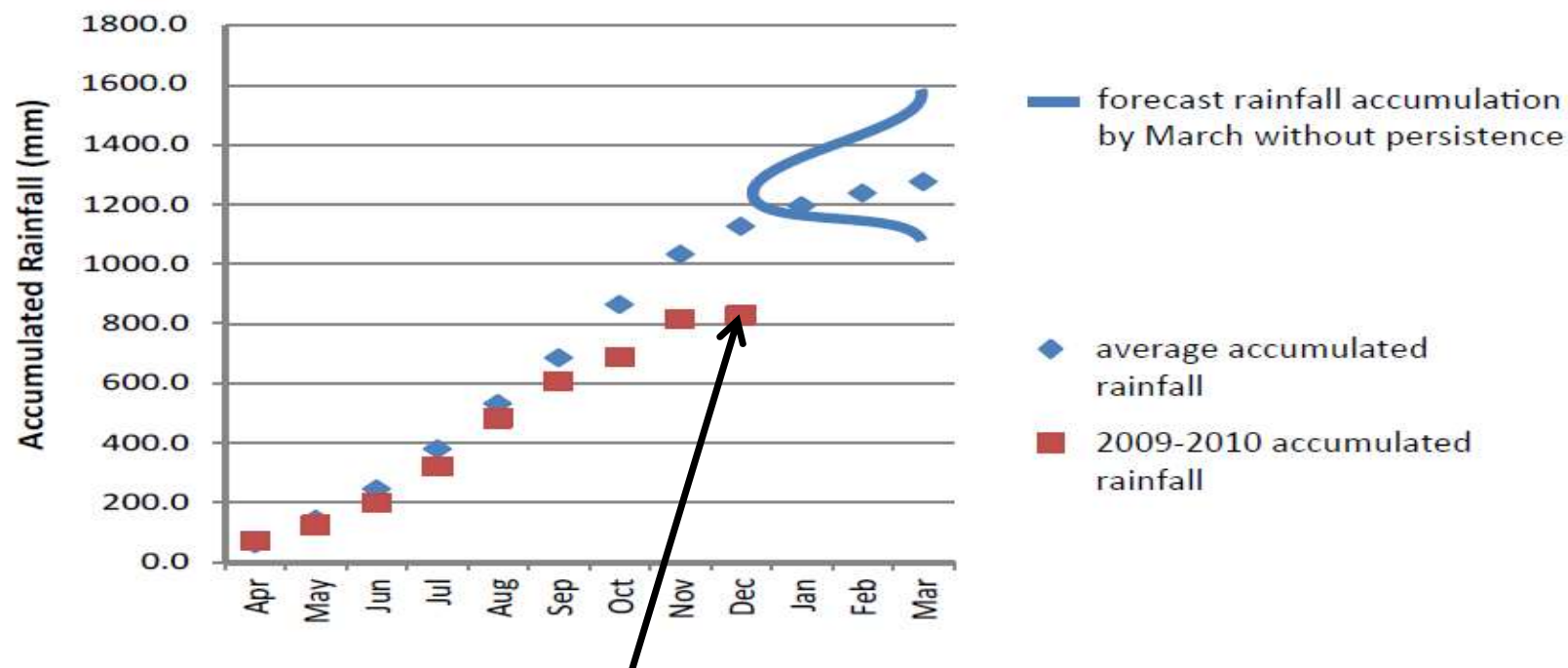
Solutions – increasing confidence by adding persistence



TRADITIONAL SEASONAL RAINFALL FORECAST

Actionable drought forecasts

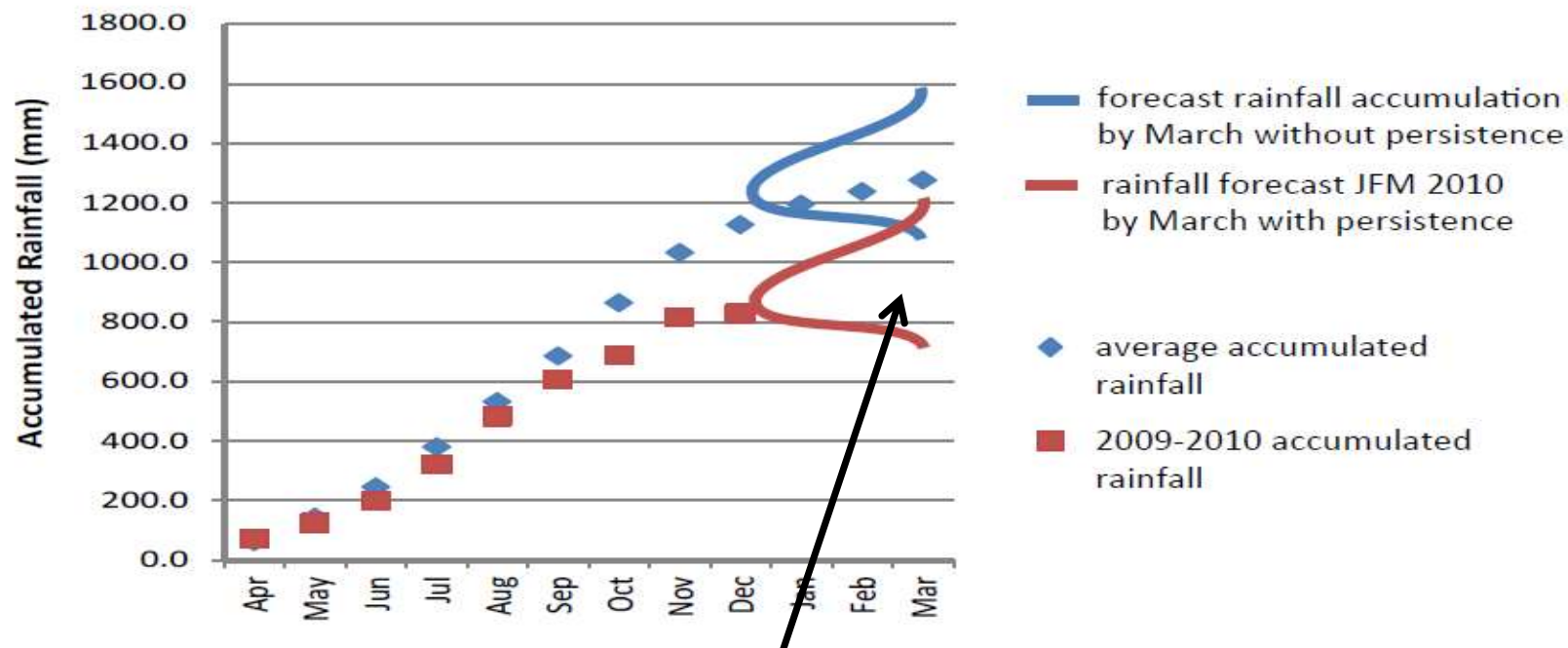
Solutions – increasing confidence by adding persistence



HOW MUCH RAIN FELL SO FAR?

Actionable drought forecasts

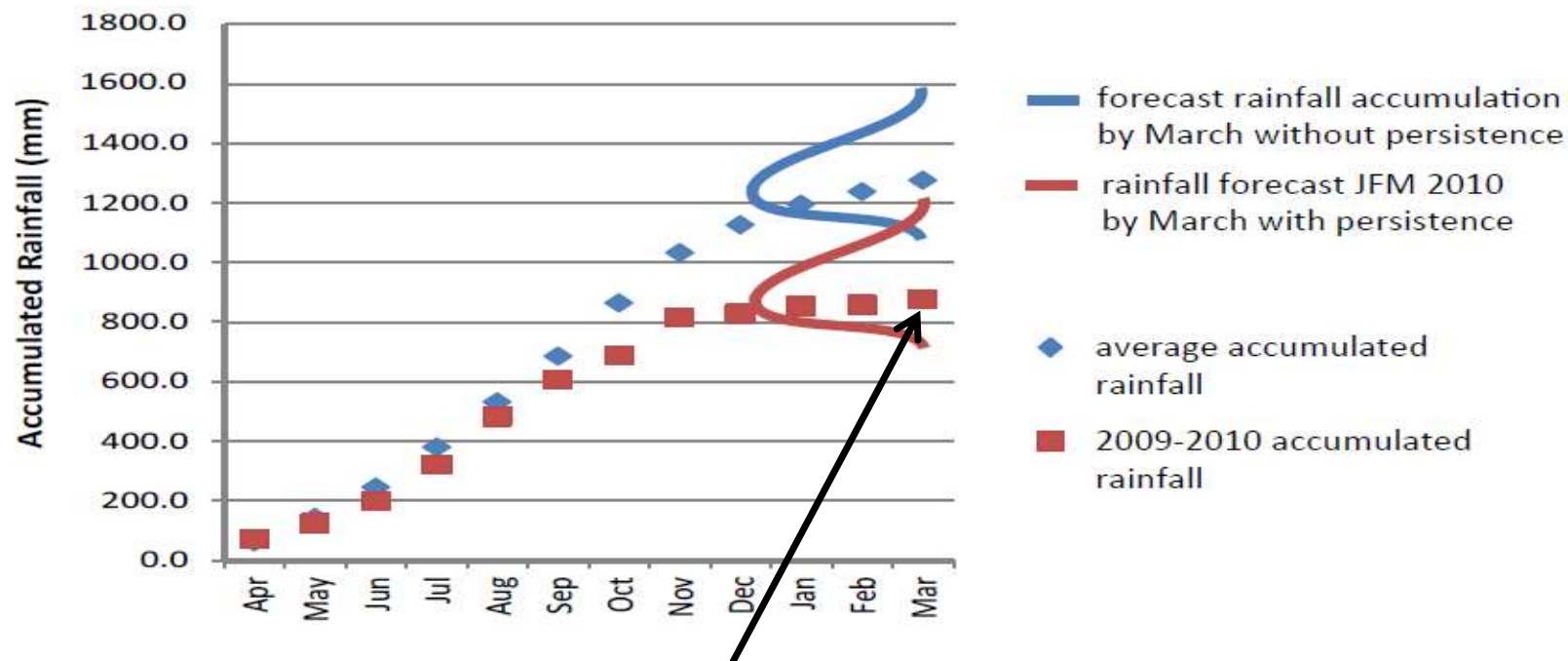
Solutions – increasing confidence by adding persistence



SAME SEASONAL RAINFALL FORECAST ...
but adding in observed rainfall

Actionable drought forecasts

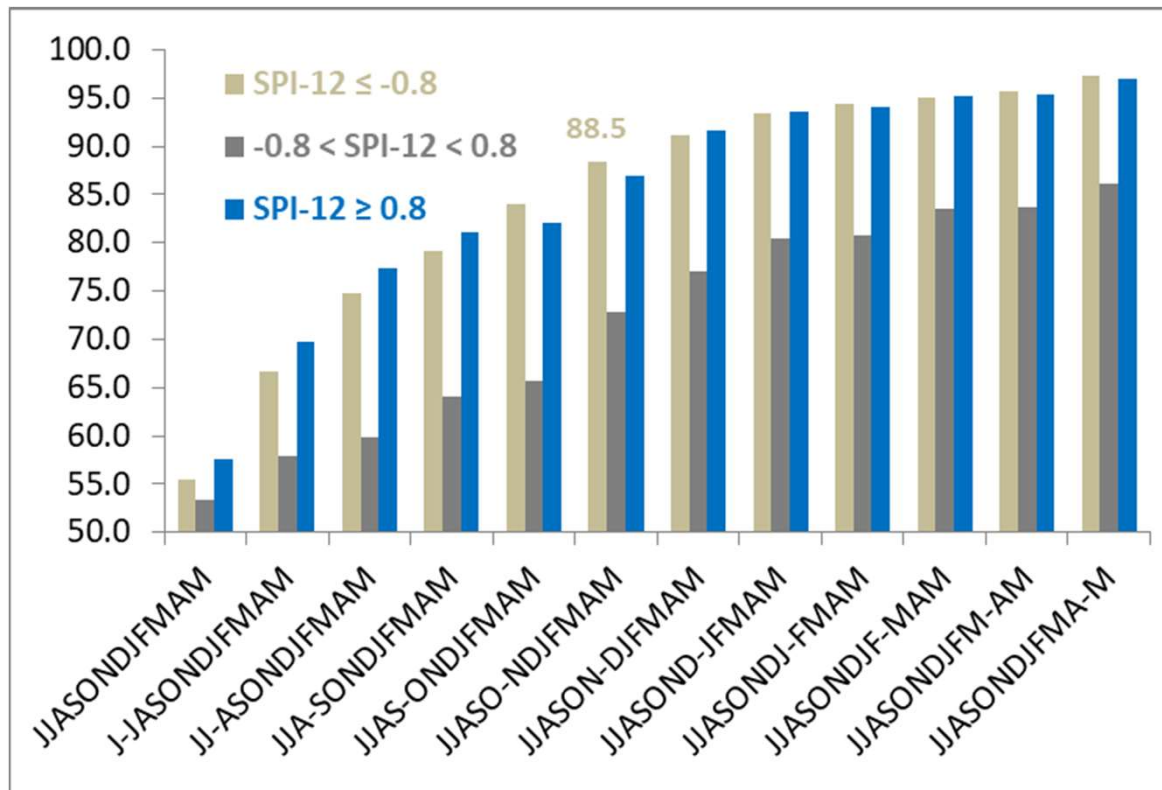
Solutions – increasing confidence by adding persistence



THIS IS WHAT ACTUALLY HAPPENED!!

Actionable drought forecasts

Solutions – optimising goodness and timeliness



CariCOF long term drought forecasts for the end of the water year **correctly detect 88.5%** of impending droughts with a **6-month time lead**

Actionable drought forecasts

Solutions – optimising goodness and timeliness

Short term drought forecasts			SPI-6 period																			
current month	What is forecast?	Expected impact level at the end of	Nov (Yr-1)	Dec (Yr-1)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan (Yr+1)	Feb (Yr+1)	Mar (Yr+1)			
Jan	Prob.(SPI-6 < -0.8)	April	OBS.					FORECAST														
Feb	Prob.(SPI-6 < -0.8)	May		OBS.				FORECAST														
Mar	Prob.(SPI-6 < -0.8)	June			OBS.			FORECAST														
Apr	Prob.(SPI-6 < -0.8)	July				OBS.		FORECAST														
May	Prob.(SPI-6 < -1.3)	August					OBS.	FORECAST														
Jun	Prob.(SPI-6 < -1.3)	September						OBS.	FORECAST													
Jul	Prob.(SPI-6 < -1.3)	October							OBS.	FORECAST												
Aug	Prob.(SPI-6 < -1.3)	November								OBS.	FORECAST											
Sep	Prob.(SPI-6 < -1.3)	December									OBS.	FORECAST										
Oct	Prob.(SPI-6 < -1.3)	January (Year + 1)										OBS.	FORECAST									
Nov	Prob.(SPI-6 < -0.8)	February (Year + 1)											OBS.	FORECAST								
Dec	Prob.(SPI-6 < -0.8)	March (Year + 1)												OBS.	FORECAST							

Long term drought forecasts			SPI-12 period																						
current month	What is forecast?	Expected impact level at the end of	Jun (Yr-1)	Jul (Yr-1)	Aug (Yr-1)	Sep (Yr-1)	Oct (Yr-1)	Nov (Yr-1)	Dec (Yr-1)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov					
Nov (Year - 1)	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED					FORECAST					←					ROC score = 88.5%							
Dec (Year - 1)	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED					FORECAST					←					ROC score = 91.1%							
Jan	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED						FORECAST				←					ROC score = 93.5%							
Feb	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED							FORECAST				←					ROC score = 94.4%						
Mar	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED								FORECAST				←					ROC score = 95.0%					
Apr	Prob.(SPI-6 < -0.8)	water year / May	OBSERVED									FORECAST				←					ROC score = 95.7%				
May	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED							FORECAST									
Jun	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED								FORECAST								
Jul	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED									FORECAST							
Aug	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED										FORECAST						
Sep	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED											FORECAST					
Oct	Prob.(SPI-6 < -1.3)	wet season / Nov.							OBSERVED										FORECAST						

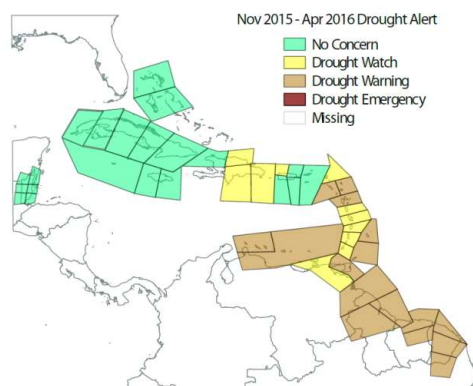
CariCOF operational forecasting schedule for short term and long term drought optimises goodness and timeliness

Actionable drought forecasts

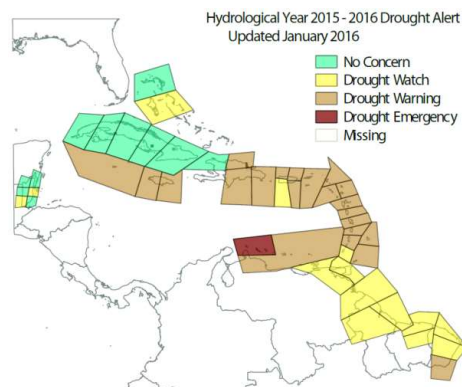
Solutions – making the forecasts relevant & understandable

Drought alert maps

Short Term
Drought alerts at the end of the dry season, based on 6-month SPI



Long Term Drought
alerts at end of wet season, based on 12-month SPI



ALERT LEVEL	MEANING	ACTION LEVEL
NO CONCERN	No drought concern	<ul style="list-style-type: none"> ✓ monitor resources ✓ update and ratify management plans ✓ public awareness campaigns ✓ upgrade infrastructure
DROUGHT WATCH	Drought possible	<ul style="list-style-type: none"> ✓ keep updated ✓ protect resources and conserve water ✓ implement management plans ✓ response training ✓ monitor and repair infrastructure
DROUGHT WARNING	Drought evolving	<ul style="list-style-type: none"> ✓ protect resources ✓ conserve and recycle water ✓ implement management plans ✓ release public service announcements ✓ last minute infrastructural repairs and upgrades ✓ report impacts
DROUGHT EMERGENCY	Drought of immediate concern	<ul style="list-style-type: none"> ✓ release public service announcements ✓ implement management and response plans ✓ enforce water restrictions and recycling ✓ enforce resource protection ✓ repair infrastructure ✓ report impacts

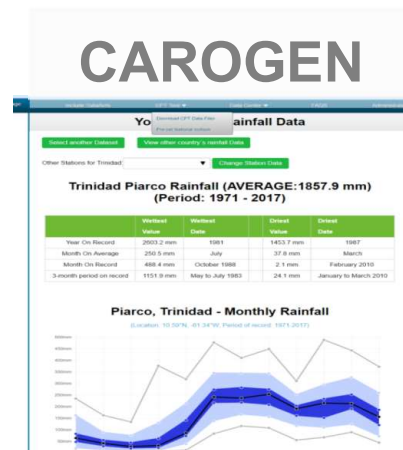
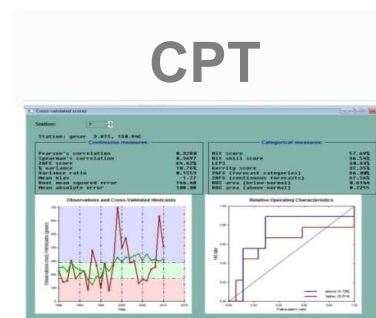
Activity began as a collaboration between CariCOF, CACOF and IRI

Forecasts are widely used by **water resources managers** and **agriculturists**

Actionable drought forecasts

Solutions – sustainability & common standard by automation

- **CAROGEN** (carogen.cimh.edu.bb) : operational platform to generate and deliver seasonal forecasts, built in-house at the Caribbean RCC in 2016.
- CAROGEN integrates:
 - the **Climate Predictability Tool (CPT)** for statistical downscaling/forecasting;
 - a **regional climate database**;
 - a **public access area** for climate statistics and monitoring tools at the weather station level.
- CAROGEN
 - **reduces effort** in producing seasonal forecasts by 2/3;
 - **ensures objectivity through a consensus-build, standard forecasting methodology** across CariCOF, the RCC and Caribbean NMHSs.



Improving sustainability and standardising forecasting process can build the perceived **authority of NMHSs** as trustworthy information source by **IT automation**.

(This is critical in human and financial resources-strapped countries, such as **SIDS**.)

Actionable drought forecasts

Solutions – packaging monitoring, outlook and alert info

Caribbean Drought & Precipitation Monitoring Network (CDPMN)

CARIBBEAN DROUGHT BULLETIN

February 2016 | Volume II | ISSUE 9

Announcement

Drought conditions continue in the eastern and southern Caribbean and has extended to the Guianas, with below normal rainfall expected at least until April. Drought concerns, with likely impacts, exist from Guyana across to Jamaica and Cayman Islands in the West into April/May 2016. Above normal rainfall is likely to curtail drought impacts anywhere from around May 2016.

Month at a Glance

Normal to below normal rainfall was experienced in the eastern Caribbean and northern Guyana in January. Trinidad, Grenada, St. Vincent, St. Lucia, Antigua, St. Kitts, Anguilla and St. Maarten were moderately dry. Tobago and Barbados normal. Dominica extremely dry. St. Croix exceptionally dry. [Read more...](#)

Headline Impacts

Lengthy drought in Domin. Rep. caused serious agriculture losses and prompted water rationing measures. [DESAffairs](#)

NAWASA is partnering with a number of stakeholders to roll out what would be a proactive and robust dry season campaign. [NAWASA](#)

The East Dominican Water Conservancy (EDWC) is at a critically low level. [Guyana Chronicle](#)

The 2016 Sugar Cane Harvest in Barbados has suffered a major blow from the drought conditions. [Bridgetown News](#)

Weather and drought to blame as food insecurity threatens in Haiti. [Caribbean 360](#)

Latest News

DECS hosts drought management workshop in Saint Lucia. [St. Lucia Herald](#)

Caribbean Drought Bulletin

Caribbean Drought & Precipitation Monitoring Network (CDPMN)

The Caribbean Drought & Precipitation and Monitoring Network (CDPMN)

The Caribbean Drought and Precipitation Monitoring Network was launched in January 2009 under the Caribbean Water Initiative (CWI). The goal of CDPMN was to increase the capacity of Caribbean countries to deliver equitable and sustainable Integrated Water resources Management (IWRM).

The concept was born out of the need to mitigate and respond to the creeping phenomenon, drought. Drought and the general precipitation status is monitored at the regional scale. Efforts are being made to enhance drought monitoring at the national level.

The Caribbean Climate Outlook Forum (CariCOF)

The CariCOF brings together climate experts and meteorological services in the Caribbean region on an operational basis to produce a monthly climate outlook. CariCOF interacts with several users to assess the likely implications of the outlooks on the most pertinent socio-economic sectors. The Caribbean Institute for Meteorology and Hydrology (CIMH), in its role as WMO Regional Climate Centre in demonstration phase, coordinates the CariCOF process. [Read more...](#)

For more information contact:

Mr. Adrian Tristram:
atristram@cimh.edu.bb

Mr. Anthony Mearns:
amearns@cimh.edu.bb

Ms. Shelly Ann Cox:
sacox@cimh.edu.bb

Website: CDPMN.DroughtMonitor.org (Site live)

Drought Outlook for the End of April

CariCOF's Drought Alert Map

Drought Outlook Nov to Apr
Areas under immediate drought concern?

Current Outlook:
● Below -0.5 SPI (moderate to severe)
● -0.5 to -1.0 SPI (moderate)
● -1.0 to -1.5 SPI (moderate to severe)
● Below -1.5 SPI (severe)

Current update (January 2016):
Drought concern is noted from Hispaniola east and southward, drought for most parts of the St. Kitts, Barbados.

Key areas of drought warning in ABC Islands, Antigua, Barbados, Guadeloupe, Guernsey, St. Kitts, Trinidad & Tobago.

Long-term drought outlook

Concerns by the end of the Caribbean dry season (May 2016, 2016?)

Current Outlook:
This 12-month SPI-based drought outlook uses observations until December 2015, with potential impacts on larger scale water resources and groundwater is assessed, impacts are expected if the 12-month SPI is a 0.5 probability dry or worse - see CDPMN.

Expected hydrological drought by the end of the dry season (May 2016) is a concern across all the Caribbean except Barbados. A drought warning is issued for western Barbados and the Leeward, except Cuba. A drought watch is also issued for parts of the Bahamas and Belize, and the rest of the Guianas.

Current Drought Situation

Because of below-normal rainfall during 2015, water shortages occur in many portions of the Antilles, notably Barbados, St. Lucia and many of the Leewards.

Nearly all island nations are in longer-term drought (except Bahamas & Cuba).

Thanks to the return of more seasonable rainfall in parts of the region during October and November, some Antilles islands are currently no longer facing severe shorter-term drought. Likewise, Belize is no longer under drought.

Shorter-term (60 April 2016):

- We expect that a shorter-term drought situation may persist from Hispaniola east- & southward, notably in ABC Islands, Antigua, Barbados, Guadeloupe, St. Kitts, Trinidad & Tobago, Guernsey.
- Longer-term (beyond April 2016):

Very strong El Niño seems to have peaked in strength. El Niño often results in a drier early part of the year in the Lesser Antilles and a failure of the secondary wet season in the northern Guianas. This may lead to drought concerns towards the end of the Caribbean dry season (i.e. May 2016).

After El Niño peaked, it tends to dissipate towards the middle – and possibly replaced by a La Niña by the end – of the year. This evolution could finally bring drought relief to the region.

Areas with existing water shortages may not see recovery until the next wet season, in particular Barbados, Belize, Cayman, central Hispaniola, Jamaica, Leewards, Trinidad & Tobago, US Caribbean Territories and Windwards.

[\[Available for download\]](#)

Caribbean Drought Bulletin

Caribbean Drought bulletin contextualises the drought forecasts by packaging drought and drought impacts monitoring, outlook and alert information.

Monitoring information for 1, 3, 6, 12 month SPI.

Updated monthly.



Actionable drought forecasts

How to?

- What makes the CariCOF drought forecasts actionable?
 - Confident by adding persistence.
 - Good & timely by optimising the forecasting schedule.
 - Relevant & understandable by presenting the forecasts as **drought alert** maps.
 - Sustainable & authoritative by **standardisation and IT automation** of forecasting process & alert map generation.
 - Contextualised by **packaging** monitoring, outlook & alert info into a drought bulletin.

Actionable drought forecasts

How to?

- What makes the CariCOF drought forecasts actionable?
 - Confident by adding persistence.
 - Good & timely by optimising the forecasting schedule.
 - Relevant & understandable by presenting the forecasts as **drought alert** maps.
 - Sustainable & authoritative by **standardisation and IT automation** of forecasting process & alert map generation.
 - Contextualised by **packaging** monitoring, outlook & alert info into a drought bulletin.
- Next step?
 - User-specific by forecasting sector-specific drought **impacts**.



Thank you!

contact the Caribbean Regional Climate Centre at:
rcc@cimh.edu.bb

For climate monitoring information, climate outlooks and climate bulletins, please visit:
rcc.cimh.edu.bb



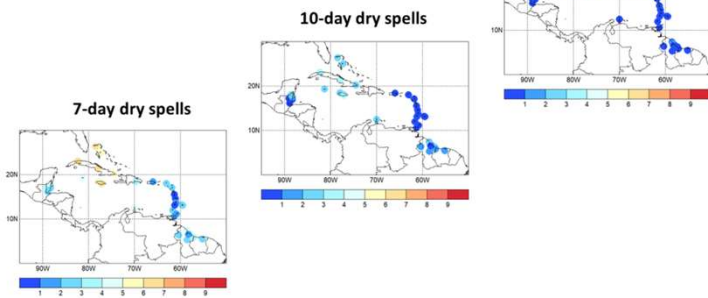
CARICOF
CARIBBEAN CLIMATE OUTLOOK FORUM



CARICOF
CARIBBEAN CLIMATE OUTLOOK FORUM

Other dryness-related seasonal climate outlooks for agriculture

How many 7-day, 10-day or 15-day dry spells do we historically get **on average** from October to December?

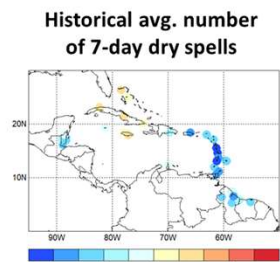


October to December 2019

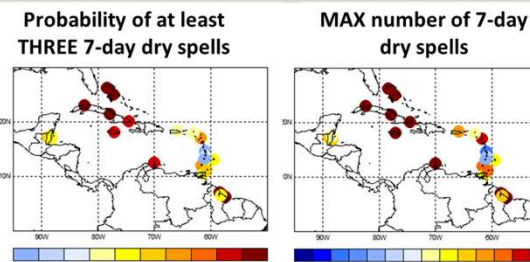
	No. of 7-dy dry spells		No. of 10-dy dry spells		No. of 15-dy dry spells	
	Climatology	Forecast	Climatology	Forecast	Climatology	Forecast
Antigua (GreenCas)	1-4	1-5	0-2	0-3	0-0	0-0
Aruba (Beatrix)	2-6	3-8	1-2	1-5	0-2	0-2
Bahamas (Freeport)	5-7	4-8	1-3	2-6	0-2	0-2
Bahamas (NewProv)	4-7	4-7	2-2	2-5	0-2	0-2
Barbados (CIMH)	1-4	1-4	0-1	0-2	0-0	0-0
Barbados (GAIA)	1-3	1-4	0-1	0-2	0-1	0-1
Belize_Belmopan	1-4	1-4	0-1	0-3	0-1	0-1
Belize (C. Farm)	2-5	1-4	0-1	0-3	0-1	0-0
Belize_Melinda	1-4	1-4	0-1	0-2	0-0	0-0
Belize_PG-Airpor	1-4	1-5	0-1	0-3	0-1	0-0
Belize_PGorda	1-4	1-5	0-1	0-2	0-0	0-0
Belize_Towerhill	3-5	2-6	1-2	1-4	0-1	0-1
Cayman	3-6	3-7	1-2	1-5	0-1	0-2
Cuba_Camaguey	5-8	3-10	2-3	2-6	0-3	0-3
Cuba_Casablanca	4-8	4-9	2-2	3-7	0-2	0-3
Cuba (Punta Maisi)	3-7	3-8	1-2	1-5	0-1	0-2
Dominica (Douglas Charles)	0-1	0-1	0-0	0-0	0-0	0-0
Dom. Republic (Las Americas)	2-5	2-6	1-0	1-3	0-1	0-1
Grenada (MBIA)	2-4	1-4	0-1	0-2	0-0	0-0
Guyana_Alshaltton						
Guyana (Albion)	3-8	3-10	1-2	1-6	0-3	0-3
Guyana_Apaikwa	1-4	1-5	0-1	0-3	0-1	0-1
Guyana_Bmont7	4-8	3-9	2-2	2-6	0-2	0-2
Guyana_BmontFron	3-7	4-8	1-2	1-5	0-2	0-2

Experimental dry spell frequency outlooks since 2017 (CIMH / CariCOF)

7-day dry spells from October to December 2019



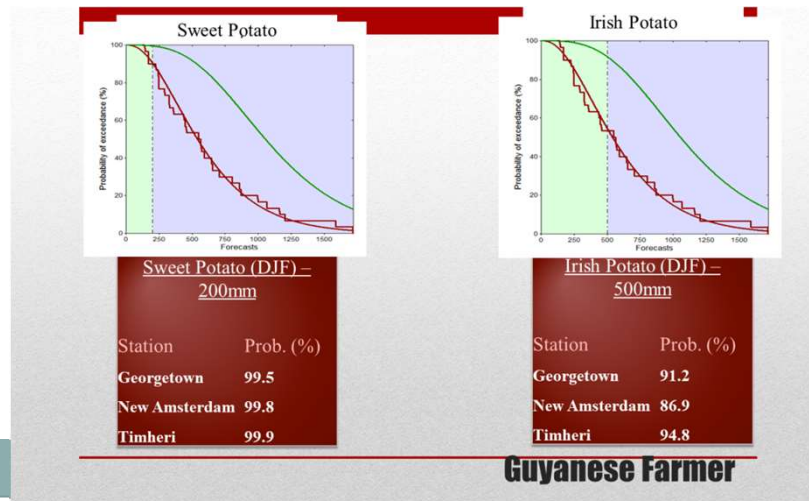
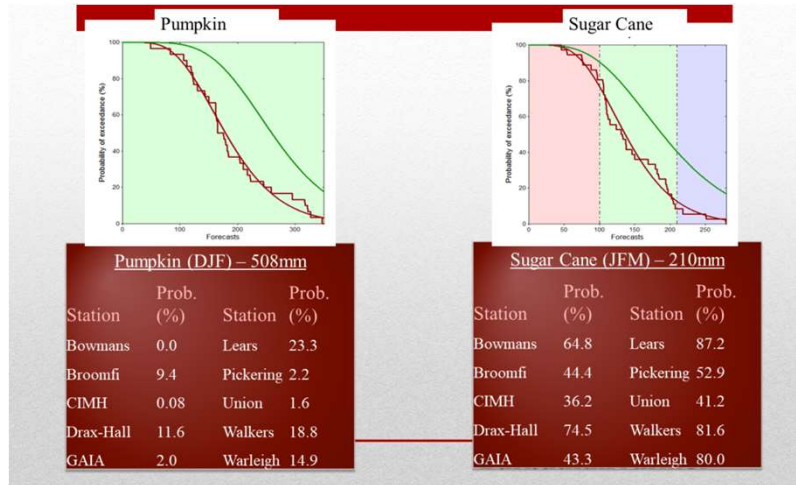
What is the FORECAST for October to December 2019?



CARICOF
CARIBBEAN CLIMATE OUTLOOK FORUM

Other dryness-related seasonal climate outlooks for agriculture

Experimental probabilistic rainfall requirement outlooks for specific crops since 2017 (CIMH / CariCOF)



CARICOF
CARIBBEAN CLIMATE OUTLOOK FORUM

CIMH coordinated regional DEWIS

