



The Caribbean Institute for Meteorology and Hydrology

Wet/Hurricane Caribbean Climate Outlook Forum

Husbands, St. James
Barbados
May 29th to June 2nd 2017

REPORT

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1. Introduction

Since the 2012 Caribbean Climate Outlook Forum (CariCOF), the Caribbean Institute for Meteorology and Hydrology (CIMH) has been coordinating climate forecasting activities leading to a consistently growing body of forecasters contributing to the monthly production of consensus-based seasonal climate outlooks, with engagement of the user community that allows awareness-building within those sector communities. In collaboration with the World Meteorological Organization (WMO), the United States Agency for International Development (USAID), Environment and Climate Change Canada, the International Research Institute for Climate and Society (IRI) and the Government of St. Vincent and the Grenadines, the 2017 Wet/Hurricane Season CariCOF took place from May 29th to June 2nd 2017 in St. Vincent and the Grenadines.

This week of activities was segmented into three main portions. The first two days involved training for meteorologists and climatologists across the region with the focus of (i) producing heat products and (ii) preparing the seasonal outlook for delivery to stakeholders. The third day hosted the forum when the climate outlook was delivered and discussed, and the final two days showcased the work of the Caribbean Early Warning Information Systems Across Climate Timescales EWISACTs and its sector-specific climate services. The meeting agendas can be viewed at <https://rcc.cimh.edu.bb/caricof/>.

This year's CariCOF was unique as it marked the first time the meeting was attended by a Head of State. The Honorable Dr. Ralph E. Gonsalves, Prime Minister of St. Vincent and the Grenadines used this forum to deliver his Hurricane season speech to the country of St. Vincent. Two other ministers also delivered speeches at various sessions, whose speeches are highlighted in this report.

1.2 Participants

Participants to the workshop were from National Meteorological and Hydrological Services (NMHSs) across the Caribbean, the CIMH, international trainers and stakeholders from the climate sensitive sectors (see [Appendix I](#)).

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2. Pre-COF Training

Meteorologists and climatologists across the region spent the first two days in training to deliver a heat product for the stakeholders. These sessions were held in collaboration with experts from the IRI where they explored the elements of a good heat product

2.1 Minister's Speech – The Honourable Soboto Caesar, Minister of Agriculture, Forestry, Fisheries and Rural Transformation

The second day of the training there was an official ceremony where the Honourable Soboto Caesar, Minister of Agriculture, Forestry, Fisheries and Rural Transformation gave the featured address. In his speech Minister Caesar alluded to the fact that there is probably not another more important discussion in the country of St. Vincent than the current CariCOF as the gathering is one of a regional collective to build a platform for policy makers to be informed scientifically for the betterment or improvement of the people. The Honourable Caesar gave the example of a dwindling banana industry as the result of the impacts of climate change – in 1992 banana production brought in around one hundred million dollars in revenue. Hurricane Tomas in 2010 destroyed 98 per cent of the industry with an expectancy of just two million dollars in revenue by year end.

2.2 Media Training

Training for the media personnel across the region was facilitated by Mr. John Toohey-Morales and Mrs. Irene Sans of ClimaData Corporation as they addressed the issue of the media not understanding the scientific message which could lead to misunderstanding. The meteorologists were also exposed to training, including how the meteorologists could leverage social media to their benefit as it was important for people to see the meteorological agencies as the authoritative voice as it pertains to weather- and climate- related events.

3. The Forum

The 2017 Wet/Hurricane season CariCOF got under way with an official opening ceremony which was attended by the Honourable Dr. Ralph E. Gonsalves, Prime Minister of St. Vincent and the Grenadines. The opening speeches are summarized in the following section.

3.1 Opening Ceremony

Dr. David Farrell, Principal of The Caribbean Institute for Meteorology and Hydrology (CIMH)

Dr. David Farrell recognized the presence of the Honourable Dr. Ralphe E. Gonsalves at the meeting and shared his pleasure that he is the first sitting Head of State attending any CariCOF. He wishes that the

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presence of the Prime Minister would be a role model for other Heads of States. As the strengths of the CariCOF process are unveiled, Dr. Farrell hopes that the donors will see that CariCOF is gaining traction in the region.

In stating that the CIMH is celebrating 50 years of service, Dr. Farrell expressed his appreciation, on behalf of CIMH, to the people of St. Vincent and the Grenadines for their continued support over the years. Dr. Farrell highlighted the importance of understanding the role of climate services and meteorological services across the region. The CIMH has been involved in supporting resilience building as well training meteorological personnel across the region. Dr. Farrell also pointed out that the CIMH, which is a recognised WMO Regional Training Centre, is now viewed as one of the best, if not the best, training centre in the world.

Other achievements of the CIMH involve supported investment in early warning systems within St. Vincent and the Grenadines. Dr. Farrell hopes that people would be better prepared and the loss of lives would decrease because of early warning systems. Owing to our changing climate, the CIMH has geared its programmes to supporting resilience. In 2007 a vision to transform the work done at CIMH was birthed. CIMH transitioned from just being a regional data centre to incorporate issues of climate services and establishing the Caribbean Drought and Precipitation Monitoring Network in collaboration with the McGill University. The CIMH also looked at providing products and services in line with the Global Framework for Climate Services (GFCS) for the health, water, agriculture and food security, energy, and disaster risk reduction sectors. Along with these five climate-sensitive sectors, tourism was included as a significant socio-economic sector to the Caribbean. One priority was how to better communicate information to the users. The Early Warning Information System Across Climate Timescales (EWISACTs) program brought sectors together in an effort to effectively filter information down to the sector level.

Christopher Cushen, Mission Director to the United States Agency for International Development (USAID) – Eastern and Southern Caribbean

In his address Mr. Cushen expressed his pleasure in representing the USAID at the 2017 Wet/Hurricane season CariCOF. He lauded St. Vincent and the Grenadines for their leadership in the Organisation of Eastern Caribbean States (OECS) as they have been proactive in driving the change process in terms of the reform of social transformation.

The CariCOF forum shows how data can be used to provide more accurate projections of the upcoming season. The USAID is pleased to support CariCOF for the ninth time and Mr. Cushen thanked CIMH for equipping regional practitioners to be able to share information for decision making.

Mr. Cushen shared that the primary objective of the USAID is to strengthen the capacity of CIMH and support the use of data for decision making. USAID's focus has been extended beyond the CariCOF to

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include increasing the product range and services delivery mechanism to national, regional and international stakeholders and enhancing the CIMH's human and technical capacities and physical infrastructure. Thus, the United States Government is pleased that the WMO has recognized CIMH (as the Caribbean Regional Climate Centre) at its Executive Council Meeting, and congratulates the CIMH on this achievement.

The USAID is focusing on the two main outputs of the CariCOF which include enhancing the capacity of CIMH and NMHSs across the Caribbean to effectively convert data into products and services to inform decision making in key climate sensitive sectors; and strengthening CIMH's climate monitoring and forecasting to enable the CIMH to feed into early warning systems and improve data acquisition networks across the Caribbean.

Mr. Cushen concluded by wishing all stakeholders a productive and thought-provoking meeting.

Honourable Dr. Ralph E. Gonsalves, Prime Minister and Minister of Finance, Legal Affairs and National Security; St. Vincent and the Grenadines

In his thought provoking and enlightening speech, the Honourable Dr. Ralph E. Gonsalves thought it fitting to use the CariCOF to make his address to his country on the verge of the 2017 hurricane season, which was delivered to the nation via live radio broadcast. Dr. Gonsalves considers CIMH to be one of the more important regional organisations in the Caribbean because the CIMH deals with issues of survival and existence. He expressed the fact that the region is not alone in the matter of climate change as there are other regions which are more powerful emitters of Green House Gases and these countries have an obligation to help the region adapt and mitigate. However, there are some countries which avoid their responsibility in upholding international legislation for Green House Gas emitters.

Prior experiences from climate variability has heightened the need to be on guard for impacts from weather systems, not only in the wet/hurricane season as the island has been faced with devastating effects from December floods (notably December 2013). The certainty of the climate is no longer there, that is why the science of meteorology is important. Dr. Gonsalves stated that we can see climate change happening right before our eyes and even though others may not want to accept the explanation for it, they ought to believe that it is real, and moreover that the climate is changing in a serious way and will have serious consequences. Dr. Gonsalves proceeded to read an excerpt from his book "Our Caribbean and Global Insecurity: Seven Essays (Caribbean Ideas) Volume 3" to remind all listeners of the importance of the matter of climate change.

Dr. Gonsalves presented the 2017 tropical cyclone outlook from the National Oceanic and Atmospheric Administration (NOAA) to his listeners and reviewed the previous seasons. He alluded to the fact that devastation does not only come from the hurricanes and it costs the country as much as 15 per cent of GDP in repayments from monies borrowed for recovery. Dr. Gonsalves cautioned listeners not to take

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storms or natural disasters for granted. Every household in St. Vincent and the Grenadines should have in its possession, a family disaster preparation manual sent out by their National Emergency Management Office (NEMO). He encouraged the people of the nation to prepare themselves and listen to the advice given. Dr. Gonsalves also expressed his reliance on the climate scientists to produce the best information for decision making for his country.

3.2 Presentations

The regional climate outlooks and the hurricane outlook were presented to the stakeholders and discussions were facilitated in respect to their decisions based on the outlooks.

3.2.1 Wet/Hurricane Season Climatology in the Caribbean and the 2016 Season in Retrospect (Wazita Scott – Assistant Climate Forecaster, CIMH)

The first presentation of the CariCOF is usually one in which the climatology of the upcoming season is presented, as well as a look back at the last year's season.

Generally, the wet season runs from May/June until November/December and coincides with the Atlantic hurricane season (June to November). Within this season atmospheric moisture and temperatures are high, and wind speeds are lower. These incidentally are factors which give rise to heat stress, especially during dry spells. The drivers of the wet/hurricane season are (i) the northward propagation of the Inter-Tropical Convergence Zone (ITCZ), (ii) the northward migration of the sub-tropical high pressure (Bermuda Azores High), (iii) Sea Surface Temperatures (SSTs) between 27⁰ C – 30⁰ C, and (iv) migration of tropical waves and other disturbances.

The peak of the wet/hurricane season is usually around September/October, when SSTs are at their highest and the ITCZ is at its most northerly position. Rainfall totals for June-July-August range from 250mm to 900mm across the region, except for the ABC Islands, Haiti and portions of The Bahamas.

The 2016 wet/hurricane season was an above average season where there were fifteen named storms (on average 10), seven of which became hurricanes (average 5.9), and of these four intense hurricanes (average 2.3). The year 2016 began as a dry year but the dry conditions were superseded by flooding in some territories in October/November. Barbados and St. Vincent and the Grenadines recorded one of its wettest months in November. Deaths were also reported in St. Vincent and the Grenadines because of the flooding. On the contrary, the Cayman Islands were battling with their driest year on record since 1997 as they experienced thirteen consecutive months of below average rainfall (from February 2016?). Ms. Scott motioned that the La Nina phenomenon, which replaced the El Nino during the last few months of 2016, tends to increase the chances of excessive rainfall and increased hurricane activity.

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3.2.2 Wet/Hurricane Season Climate Outlook – rainfall, temperature, wet days/wet spells, hurricanes and drought outlooks/ coral bleaching outlook (Desiree Neverson-Jack, St. Vincent and the Grenadines Meteorological Service)

The 2016 wet/hurricane season outlooks were presented by Mrs. Desiree Neverson-Jack of the St. Vincent and the Grenadines Meteorological Office. The key messages from the outlooks were:

Rainfall

June-July-August

Rainfall in the Caribbean is likely to be above-to-normal in Belize, western Guianas, the Greater Antilles (except the Cayman Islands) and the Leeward Islands; but below-normal to normal in the ABC Islands and Trinidad and Tobago.

September-October-November

Rainfall in the Caribbean is likely to be above – to normal in The Bahamas, Belize, the Cayman Islands, Cuba, northern Hispaniola; but below – to normal in Barbados, the Guianas, Trinidad and Tobago and the Windward Islands.

Temperature

Day and night-time temperatures are likely to be above normal across the region throughout the wet season.

Heat

This year's CariCOF introduced a new experimental Heat Outlook product, with a forecast of increased heatwave days for June through to November, with some locations possibly experiencing heatwaves one-third of the time. There is also more than a 50 per cent chance of having at least 30 heatwave days in many places. Further, the Lesser Antilles (except Grenada and Trinidad and Tobago) has a 80 per cent chance and 50 per cent chance for at least 14 and 60 heatwave days respectively.

These outlooks can be accessed via <https://rcc.cimh.edu.bb/caricof-climate-outlooks/>.

3.2.2.1 Climate Outlook Discussion

After the delivery of the 2017 wet/hurricane season outlook, participants were invited to discuss the information, and this is captured below.

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Michelle Nurse, CARICOM Secretariat: Ms. Nurse noted that there is only precipitation data from the airport stations and enquired how other locations within the country could be incorporated for analysis.

Dr. Cedric van Meerbeeck, CIMH: Dr. Meerbeeck in his response indicated that they are some weather stations, as well as rain gauges, which have recently been set up at other locations across some territories. Long rainfall records would be necessary for climatological analysis. Moreover, some local meteorological services report on monthly rainfall across their country in their local bulletins.

Adisa Trotter, Ministry of Agriculture (Dominica): Mr. Trotter's question was geared towards the accuracy of the last wet season forecast.

Dr. Cedric van Meerbeeck, CIMH: The last season's forecast was verified a few days ago where all areas of predicted increasing precipitation did materialize, except in Belize, Cayman Islands and the Bahamas. The forecast verification information can also be found on the RCC's website.

Sherrod James, Antigua and Barbuda: Mr. James asked whether there was any information on the expected duration of a wet spell.

Dr. Cedric van Meerbeeck, CIMH: a wet spell is defined as a period not shorter than 7 days with rainfall greater than the 80th percentile.

3.2.3 Break-out Groups

Participants discussed the implications of the forecast to their sectors and gave recommendations. The responses are recorded in [Appendix II](#).

3.2.4 Dust and Air Quality Forecasting for the Caribbean using WRF-Chem (Dr. Andrea Sealy – Meteorologist, CIMH)

Dr. Sealy alluded to the fact that, annually, significant amounts of desert dust travels to the Caribbean from the Saharan region. These concentrations of dust quite often exceed the World Health Organisation (WHO) and the United States Environmental Protection Agency (EPA) standards of PM¹_{2.5} and PM₁₀. To this end, CIMH has been established as a WMO Sand and Dust Storm – Warning and Alerting System (SDS-WAS) node for the Pan-American region, which provides dust and air quality forecasts for the Caribbean using the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem).

Research has shown that about half of the dust mass brought to Barbados on the Trade Winds is PM_{2.5} and over 90 per cent is PM₁₀. Also, during dusty years, the 24-hour PM_{2.5} standard is exceeded 10 – 20

¹ Particulate Matter

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times. The greatest changes in dust transport occurs in periods December-January-February and March-April-May.

Surface and satellite observations of the most recent dust episode (April 1 – 4, 2017), which affected the Eastern and South-eastern Caribbean, indicated high levels of dust in the region. The WRF_Chem 7-day forecast model, initialized March 27th showed significant dust levels expected across the Caribbean region (notably across the South-eastern Caribbean). High levels of surface PM₁₀ (60 – 120 µg/m³) were expected across the Eastern Caribbean, which exceeded the guideline for WHO 24 hour mean of 50 µg/m³. Hazy conditions were reported in Trinidad and Tobago and there was public interest in the perceived effects of the dust levels on respiratory illnesses and conditions.

The CIMH WRF-Clem model predicts dust episodes 5 – 7 days in advance, outperforming the NRL/NAAPS and ICAP MME forecast models². Having the model operating at a higher resolution and enhancing the network of PM_{2.5}/PM₁₀ observations are a part of future plans.

3.2.4.1 Discussion

Dr. Simon Mason, IRI: Dust reduction seems to be a problem in terms of mitigating. What can we do practically to try to mitigate the negative effects?

Dr. Andrea Sealy, CIMH: Products could be shared to help reduce the negative effects. The health sector should be prepared for any overloads (hospitals, clinics, pharmacies etc.).

Shermaine Clauzel, Caribbean Public Health Agency (CARPHA): Have there been any studies on disease carrying agents from the dust?

Dr. Andrea Sealy: There have been some studies done in West Africa but not sure of any done in the Caribbean.

Sally Edwards, Pan American Health Organization (PAHO): Some air quality issues are not from dust. Do you have any idea of the proportion attributed to dust?

Dr. Andrea Sealy: Experts from the Chronic Research Centre at the University of the West Indies (UWI) have a focus on pollens and humidity with a finding of positive correlation in humidity with asthma.

² Naval Research Lab models <https://www.nrlmry.navy.mil/aerosol/>

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3.2.5 Caribbean Heat Outlooks: Research and Product Development (Dr. Simon Mason, IRI; Dr. Cedric van Meerbeeck, CIMH)

In this presentation on developing heat products for the region, Dr. Simon Mason of the IRI reviewed heatwave problems in other parts of the world in an effort to show why heatwaves would also be of concern in the Caribbean. In Russia, the average daily maximum temperature in August is around 21 °C but in August 2010 temperatures rose to 15 °C above average, giving rise to a near 55, 000 death toll across the country. Also in 2010, there were an excess of 4,462 deaths from heat in India.

Data analysis in the Caribbean shows that the frequency of warm days has increased by 15 per cent; a 1 per cent warming of hottest days and nights; a 7 per cent decrease in the frequency of cool days; a 10 per cent decrease in the frequency of cool nights; and 1 per cent warming of coldest days and nights. Although experts are unable to quantify the impacts of heatwaves in the Caribbean, what they do know is that there must be concern over them because they have before caused major impacts in other regions. Heatwaves also have a stronger meteorological impact than any other meteorological hazard in many places and how warm/hot days and nights are becoming more frequent in the Caribbean. Heatwaves can impact sectors as they impact human health thereby reducing labour productivity. Crop and livestock survival is of concern during heatwaves and infrastructure is also impacted. Heatwaves put added pressure on energy by increasing cooling demands.

Adapting the definition of a heatwave to best suit the Caribbean is given as such:

A heatwave is a period of at least two consecutive days with maximum temperatures above the 90th percentile.

Using this definition historical heatwave events were analysed across the Caribbean and the seasonality was grouped according to region (**Fig. 1**).

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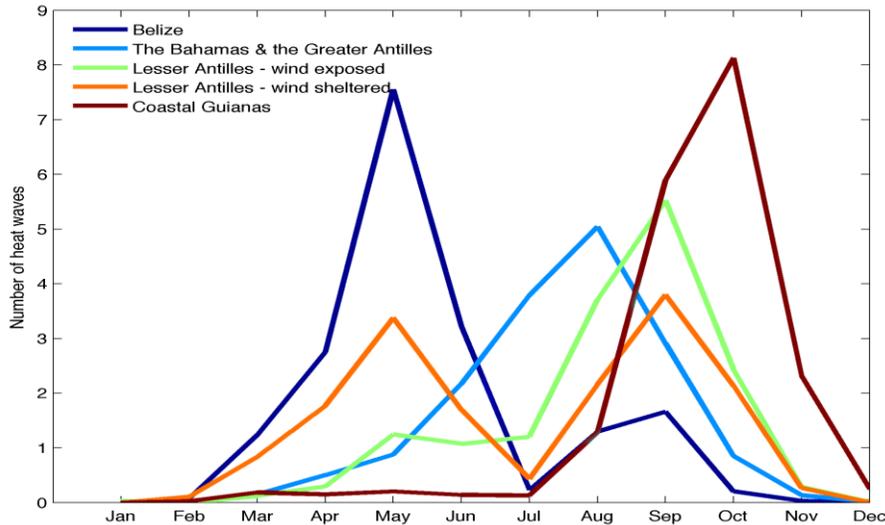


Figure 1: Heatwave Seasonality across the Caribbean

At least a few heatwave days are counted in most territories between June and November, with most occurring between August and October. The heat outlook for June to November 2017 suggests that there could be an increase in heatwave days, with some locations experiencing heatwaves 1/3 of the time. Such a forecast implies that heat stress from heatwaves could affect human populations or livestock as there may be much more discomfort related to very warm temperatures than in recent months. These products can be viewed at <https://rcc.cimh.edu.bb/caricof-climate-outlooks/heat-outlook/>.

3.2.6 Implementing an Impacts-Based Forecasting and Decision-Making Framework to Enhance Disaster Risk Reduction in the Caribbean (Shawn Boyce, CIMH)

Mr. Boyce presented excerpts from a paper authored by himself and other CIMH? colleagues where he showcased the implementation of a hydro-meteorological impact-based forecasting and decision-making framework that enhances disaster risk reduction in the region. The expected increase in extreme events due to climate change and climate variability makes the discussion of an impacts-based forecasting framework relevant and necessary. The context of the discussion was based on the Sendai Framework for Disaster Risk Reduction 2015 – 2030. This framework has seven targets that aim to sustainably reduce disaster risk, loss of life and livelihoods.

In terms of impacts forecasting, at the regional level, it will include the provision of quantitative hazard information while considering existing exposures and vulnerabilities. The Caribbean Dewetra Platform (CDP) will facilitate such impacts forecasting. The CDP is a spatio-temporal decision-making, data fusion

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platform which is capable of seamlessly integrating evolving hazard data, socio-economic, exposure and vulnerability information in support of impact-based forecasting. Since 2007 the CIMH had been providing impacts-based tropical cyclone forecasts to the Caribbean Disaster Emergency Management Agency (CDEMA), and this partnership contributes to the Caribbean Disaster Management strategy and Sendai Framework priority areas for action through strengthening institutional arrangements at the national and regional level and improving the understanding of risk through the provision of real-time access to data.

3.2.7 Caribbean Drought Planning Exercises (Adrian Trotman, CIMH)

The characteristics of rainfall across the Caribbean has raised concerns over drought. At least 70 per cent of rainfall occurs during the wet season, leaving not more than 30% over the other half of the year – the dry season. Further, rainfall in the Caribbean is cyclical (50 to 60 years), and during its low phase, there is greater chance for drought occurrence. This, along with a prediction of reduced rainfall and increased warming in the future are likely to enhance and increase the frequency of drought episodes. Mr. Trotman identified three main drivers that would cause drought impacts: (i) an early start to the dry season, (ii) a late end to the dry season, or (iii) a significant reduction in dry season rainfall. Sometimes, there may be combinations of two or all three of these. The circumstances can be further compounded by a wet season that yielded significantly below normal rainfall.

Drought monitoring on a regional scale in the Caribbean began with the establishment of the Caribbean Drought and Precipitation Monitoring Network (CDPMN), launched under the Caribbean Water Initiative (CARIWIN) in 2010. The CDPMN also has the capacity to monitor drought at the national level. At the regional level, monitoring is done using the Standardized Precipitation Index (SPI) whereas at the national level other factors which determine the severity of the drought situation (water resources and vegetation) need to be integrated.

Currently, the regional products that are used to monitor drought include the SPI Monitor and the Drought (SPI) Outlook. Recently, the SPI Difference monitor, that provides some insights as to whether the level of drought has been increasing or decreasing from month to month has been added to the suite of products. These products can be accessed from <https://rcc.cimh.edu.bb/>. These products are integrated into a bulletin - the Caribbean Drought Bulletin - which is shared across the region. However, for the information to be responded to effectively, drought management policy and plans are necessary. The drought policy, executed through the national drought plan, would entail a course of action for addressing any drought that develops. An effective drought plan comprises of a monitoring and early warning system, risk assessment, and mitigation and response actions. Some Eastern Caribbean countries are on their way to developing their national drought plan. Those eastern Caribbean countries have first been

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completing terms of reference for national drought management committees, and amending national disaster risk management documents to more explicitly incorporate drought as a hazard to be managed.

3.2.8 A Discussion of the Climate in the Regional Track of the PPCR (Ainsley Henry, UWI Mona Campus)

The Pilot Program for Climate Resilience (PPCR) is executed globally through nine national programs and two regional programs, in which the Caribbean region is one of the regional programs with six participating countries (Jamaica, Haiti, Dominica, St. Lucia, Grenada, and St. Vincent and the Grenadines). The key objectives of the PPCR are to (i) to help improve the regional process of climate relevant data acquisition, storage, analysis, access, transfer and dissemination, and to pilot and scale up innovative climate resilient initiatives, (ii) seek to generate data and develop information products and services at a regional level that can be utilized at both the regional and national levels, and (iii) to enhance the utilization of climate data and information for decision-making purposes.

3.2.9 Advances in Tailored Climate Early Warning Information for the Caribbean (Roche Mahon, CIMH; Shelly-Ann Cox, CIMH)

In keeping with the vision of the Global Framework for Climate Services (GFCS), advances in tailored climate and early warning information for the Caribbean have been established through series of climate monitoring and climate outlook products. The vision of the GFCS is “to enable society to better manage the risks and opportunities arising from climate variability and change, especially for those who are most vulnerable to climate-related hazards” (WMO, 2011, 2014).

A baseline study done in 2015 showed that only four National Meteorological and Hydrological Services (NMHSs) have been able to convene a National Climate Outlook Forum (NCOF) and for some NMHSs, it was the first time they interacted with sectors other than agriculture and/or water. In an effort to close gaps between the climate service provider and the sectors, a six-step methodological approach was conceptualized where some progress have been made to date (**Fig. 2**).

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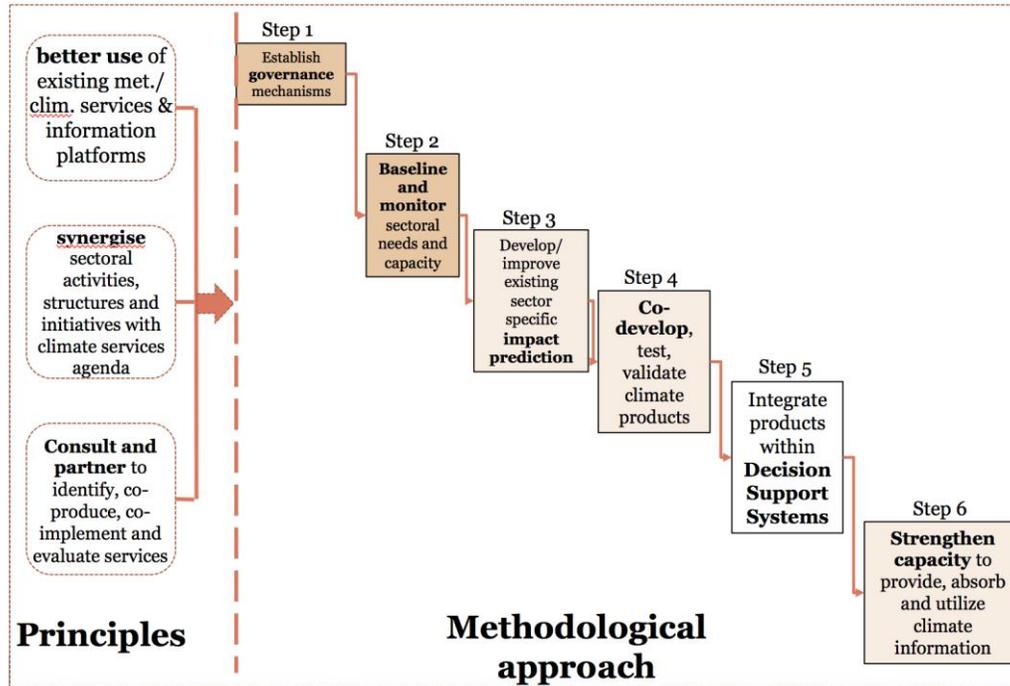


Figure 2: Progress on methodological approach

The advancement of tailored climate early warning information in the Caribbean has been successful where the CIMH sought to get validation and buy-in at the highest levels (particularly from CARICOM's Ministerial Council for Trade and Economic Development). Then sectoral buy-in was sought at the highest levels with the establishment of the Caribbean Early Warning Information Systems Across Climate Time Scales (EWISACTS) Consortium. EWISACTS brings together regional agencies with lead responsibilities in key climate sensitive sectors and climate service providers. This regional body of agencies include: Caribbean Agriculture Research and Development Institute (CARDI), Caribbean Public Health Agency (CARPHA), Caribbean Water and Wastewater Association (CWWA), Caribbean Disaster Emergency Management Agency (CDEMA), Caribbean Tourism Organization (CTO) and the Caribbean Hotel and Tourism Association (CHTA), and CIMH. CIMH is currently in discussion with the Caribbean Centre for Renewable Energy and Energy Efficiency (CCREEE) to participate in this partnership on behalf of the regional energy sector.

In an effort to design user-oriented climate information, social science approaches were integrated where assessments of sectoral users' perception and use of climate information were conducted. These assessments provided guidance to the development of usable information for the region. A more in-depth national level assessment of sectoral needs was conducted in five countries (Barbados, Trinidad and

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Tobago, Dominica, Belize and Jamaica). To date, the CIMH has worked with the sectoral partners at the regional level and have developed two new climate bulletins (health and tourism) and one enhanced bulletin (agriculture).

The key lessons learnt were:

1. The development of climate services requires large, incremental and continuous investments in:
 - Robust monitoring and observations systems
 - Sophisticated research, modelling and prediction capacity
 - A dissemination mechanism that is versatile enough to interface with diverse user groups
 - Capacity building on both the provider and user sides of the climate services spectrum
2. Further investigation is needed to tailor climate information to the specific operating context of a range of socio-economic sectors.
3. Challenge of reconciling paradigm differences across stakeholders from the physical science and social science communities.

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Appendix I: Participant List

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PROGRAMME
Programme for Building Regional Climate Capacity in the Caribbean

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Appendix II: Sector Group Discussions

Disaster Risk Management Group

Overview

Details of the forecast

Some concepts discussed: wetter than normal or dryer than normal - discussions proved that these phrases were interpreted differently within the group. The Met representatives clarified. (For example - dryer than normal does not necessarily mean drought)

Cross cutting concepts

Precipitation

Temperature

Wind

Culture

Vulnerable Populations - youth, elderly, physically challenged

Possible events (varied according to location)

Flash-flood

Landslides

Heatwave

Drought

Dust in air

Implications

- illegal sand mining
- health issues
- social issues

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Recommendations

Recommendations were looked at in term of time frame - short or medium to long term as well as things we had the power to change or to influence change as opposed to things we cannot change and must accept as it.

Regional

Wetter than normal - seek sub-regional support mechanisms

Support from the sub-regional focal points that support various sub-regions e.g. The Windward islands or Haiti

Networking opportunities - Legislation

National

Policy Level (Longer term)

- ensure the development or enhancement or enforcement of policies such as Water Management Policy or Crowd management policy
- Integrate considerations for specific factors (e.g. Heat wave) into crowd management policy - messages before and at mass crowd events
- integrate concepts into Child-friendly School Policy

Prevention and Preparedness - robust education and awareness

- conservation messages
- Drain clearance and clean up campaigns
- Vector control and surveillance

Mitigation

- Improved water storage
- building codes enforced and monitored
- clean up campaigns

Response and Recovery

- EWS
- shelter readiness

Use of technology - development of or inclusion of messaging in Apps

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Tourism Group

Implications of the Forecast

- **Normal to wetter than usual wet season for destinations in the north:**
 - Disaster risk (concern of flash flood, flooding and landslides)
 - Disruption of outdoor activities (eg. Antigua). For countries prone to drought (eg. Antigua, SKN), may be an opportunity to recharge
 - *Aedes aegypti* proliferation risk
- **Second half of the wet season may end up drier than usual for destinations in Windwards and southwards:**
 - Possible low water availability
 - Possible agricultural decline and implications for local cuisine
- **Heat/heatwaves due to increased temperatures:**
 - Visitor heat stress;
 - Increased mosquito proliferation and possible outbreaks of dengue, Zika, yellow fever etc

Recommendations

- **Normal to wetter than usual wet season for destinations in the north:**
 - Review operational disaster mitigation and response plans
 - Promote indoor tourism activities
 - Terminology used for climate/weather conditions
- **Second half of the wet season may end up drier than usual for destinations in Windwards and southwards:**
 - Invest in water catchment measures
 - Invest in contingency menu planning and stocking/preservation of certain agricultural products
- **Heat/heatwaves due to increased temperatures:**
 - Collaborate with Health sector on heat stress and vector control
 - Plan for increased cooling costs
 - Educate guests and hotel staff on energy efficiency

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- Offer complimentary water, insect repellent and cooling areas and mechanisms (misting) to guests

Agriculture and Water Group

There were only two countries representing this sector, Saint Vincent and Guyana.

Saint Vincent:

Given that St. Vincent depends solely on surface water, the forecast was particularly important for this country. The representative noted that it would be more useful for the country to use the short-term SPI, however, noting the low predictability for surface water as it relates to El Nino.

The representative further noted that with the predicted higher temperatures they would have to put systems in place to address the impacts of this. He referred particularly to the decrease in water in the drier half of the season which increases the presences of algal blooms in reservoirs.

Guyana:

The representative noted that the information provided will be useful particularly for mitigating the impacts of the drier half of the season particularly in the hinterland areas that depend on surface water sources. This further means that the storage capacity can be increased during the wetter half of the season and distribution sites for during the drier half of the season.

The representative further enquired about longer term forecasts to aid countries that use groundwater sources and was informed that CIMH is currently working on this.

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