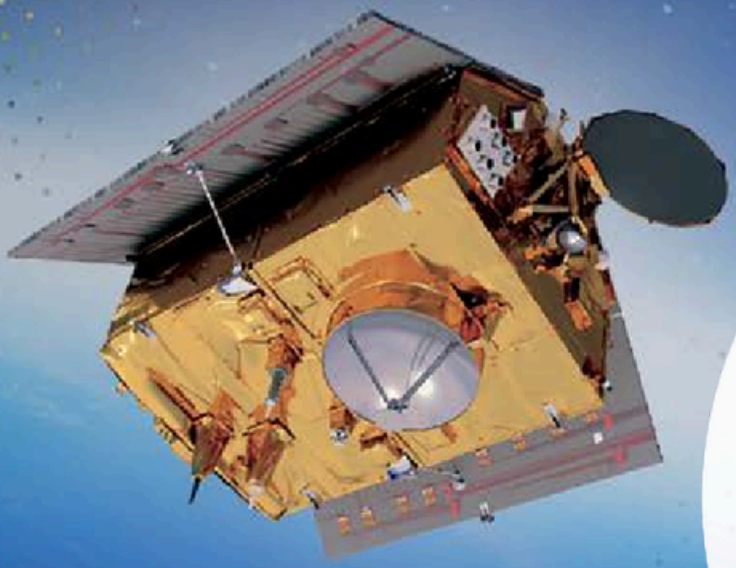
The Intra-ACP Climate Services and Related Applications Programme

Brief for Water Sector Policymakers

Weather, Water and Climate Services: Exploring Partnership and Investment Options









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CARIBBEAN METEOROLOGICAL ORGANIZATION

Caribbean Institute for Meteorology and Hydrology CIMH

ClimSA

INTRA-ACP CLIMATE SERVICES AND RELATED APPLICATIONS PROGRAMME

An initiative of the Organisation of African, Caribbean and Pacific States funded by the European Union

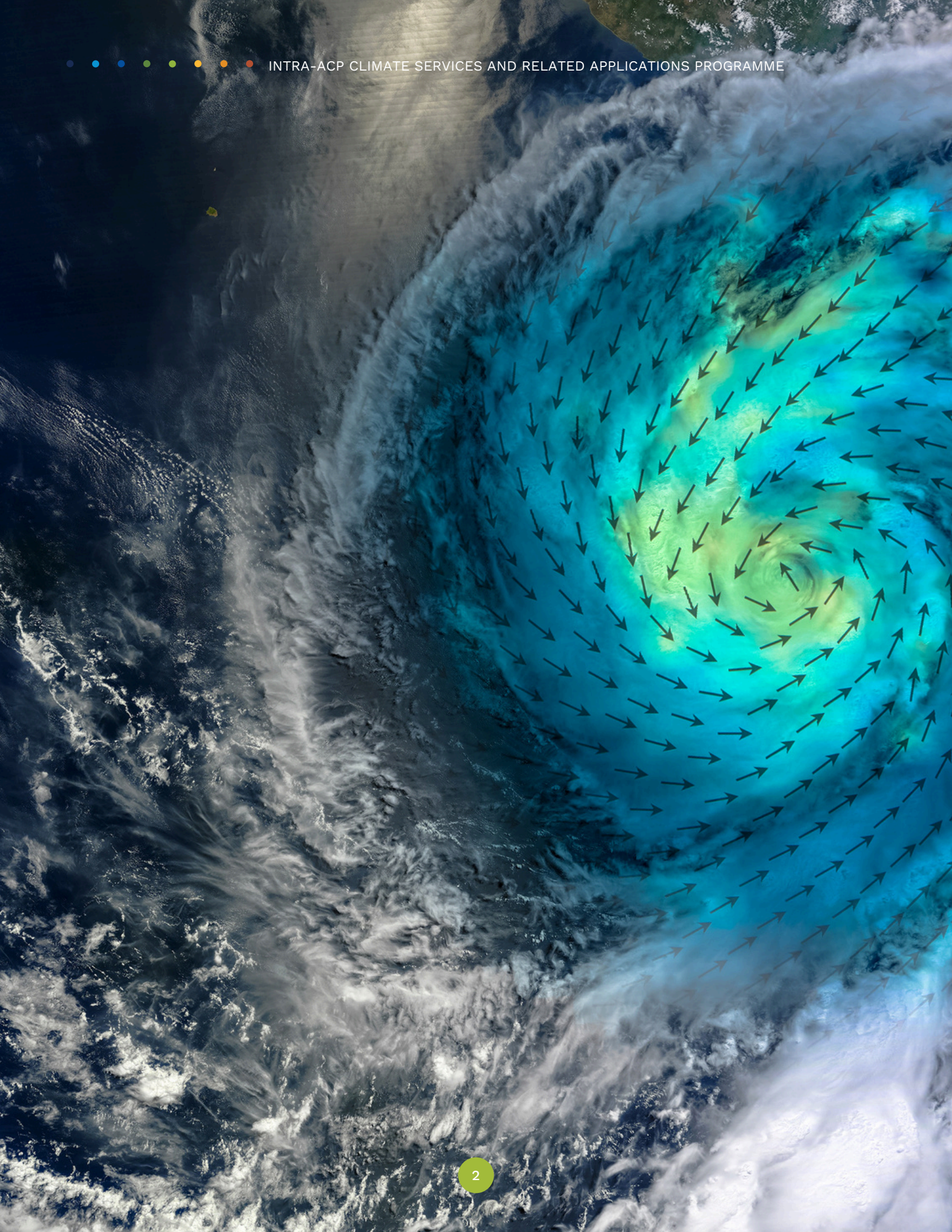


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Summary

Key Messages & Recommendations

Summary

This Brief

- Summarises the significant impacts of extreme weather and climate on water security;
- Discusses critical issues in building resilience to the impacts of extreme weather and climate events on water security within the Caribbean;
- Highlights the suite of products and services produced by the Caribbean Institute for Meteorology and Hydrology (CIMH), in part through the World Meteorological Organization-designated Caribbean Regional Climate Centre (RCC), that can assist water policymakers in their decision making and planning; and
- Highlights the important role of National Hydrological Advisers.

Key Messages

1. Climate and weather events continue to impact the Caribbean water sector. Severe impacts are expected to increase in a changing climate without appropriate mitigation measures.

2. Water practitioners need to be better equipped to make climate-smart decisions through the increased and enhanced use of freely available and accessible early warning products from the CIMH and other reputable sources of information.

3. There is an opportunity to partner with the CIMH and its network of National Meteorological and Hydrological Services to upgrade, expand, and mainstream the use of the suite of weather and climate early warning information tools available for application to the water sector.

4. There is an opportunity to engage with the World Meteorological Organization (WMO) through National Hydrological Advisers to enhance water resources management at the national level.





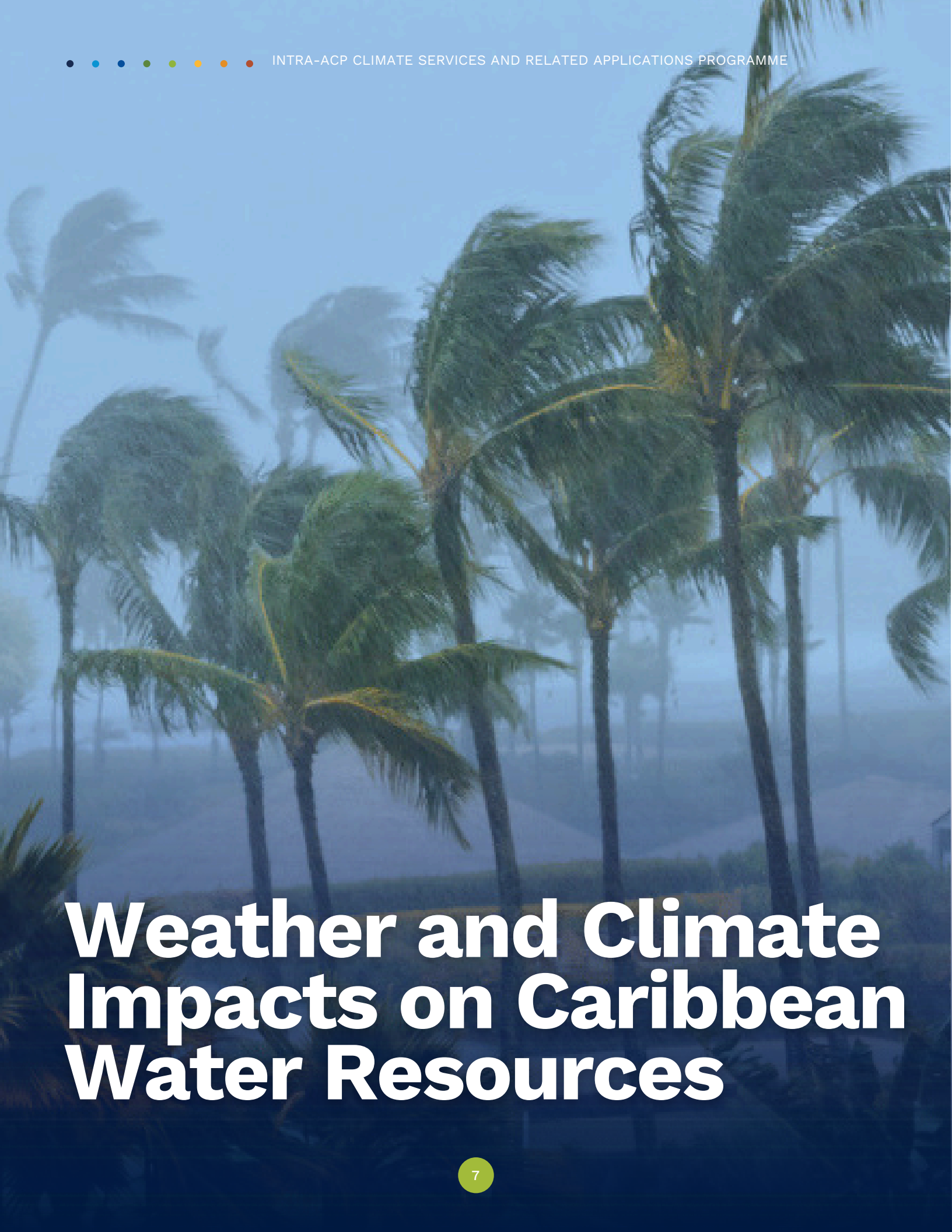
Key Recommendations

Investing in the development and mainstreaming of weather, climate and hydrological early warning information at national and regional levels.

Specific investment areas include:

1. Improving the provision of integrated weather, climate and hydrological information for water resources management

- Support the maintenance, enhancement and management of the hydro-meteorological observation network in critical watersheds to facilitate the near real-time transmission of data; and
- Invest in foundational Research & Development (R&D) for a new generation of operational weather and climate early warning information products, services and tools tailored for water resources management.
- Supporting practitioner application of weather, climate and hydrological information
- Support the development of National Committees for Climate Services that facilitate closer working relationships between water practitioners and the National Meteorological and Hydrological Services;
- Support the development and/or enhancement of National Flood and Drought Management Plans;
- Support training, capacity-building workshops and regional initiatives that enhance the abilities of water practitioners to interpret and apply weather and climate information to support informed decision-making at the national level; and
- Support the integration of the National Hydrological Adviser within the national decision-making framework.



Weather and Climate Impacts on Caribbean Water Resources

Weather and Climate Impacts on Caribbean Water Resources

Of the natural hazards experienced by Caribbean Small Island Developing States (SIDS), weather and climate hazards are the most prevalent, with their frequency and intensity expected to increase due to global climate change (Boyce et. al., 2017).

These hazards produce annual national losses (multi-sectoral) capable of exceeding 100 percent of a country's Gross Domestic Product (GDP) in some cases.

WATER SCARCITY DUE TO DROUGHT

As a result of the 2009-2010 drought, 25% of onion production and 30% of the tomato crop were lost in Antigua and Barbuda in 2010 while in Guyana's Region 2, the desperation for water by some rice farmers resulted in them pumping saline water to about 150 acres of rice lands despite the potentially grave long term consequences of such actions (Farrell et al, 2010).

The 2014-2016 drought resulted in decreased agricultural production and increased food prices in at least 10 Caribbean territories (Trotman et al., 2018). More recently, in 2019, Belize suffered an estimated USD 25 million in crop losses due to drought (The San Pedro Sun, 2019) and, similarly, in Jamaica an estimated 5,600 farmers were affected with losses of approximately 500 hectares of crops (The Jamaica Observer, 2019).



TABLE 1: SOCIO-ECONOMIC IMPACTS OF THE 2009-2010, 2014-2016 AND 2019-2020 DROUGHTS

SECTOR	DROUGHT IMPACT(S)
WATER	• *Drying of reservoirs* – In 2010, water levels fell significantly below the designated safe level for irrigation in the East Demerara Water Conservancy, Guyana (EDWC) (Cashman, 2014). • *Increase in consumption of desalinated water* - Potworks Dam in Antigua was only 10% full by the end of 2014. By the end of 2015, consumption of desalinated water was greater than 90%, compared with the norm of 60%. • *Shortage of supply* – On April 6, 2020, the Central Water and Sewage Authority in St. Vincent and the Grenadines announced service interruptions at night, adding that shutdowns may also have to occur during specified daytime hours. By May 29, the country was operating at 35% of its capacity over 5 of its major water systems and therefore continued with water rationing (Trotman, Mahon, Van Meerbeeck and Riley, 2021).
AGRICULTURE	• *Loss of crops and livestock* – In 2010, 25% of the onion crop in Antigua and Barbuda was lost, whilst about 30% of the tomato crop was lost (Trotman & Farrell, 2010). • *Increased food prices* – By March 2010, there was a 61% increase in the price of fruit in Trinidad and Tobago (Trotman & Farrell, 2010). • *Decrease in agricultural production* – A general decline in production was reported in Anguilla, Antigua and Barbuda, Barbados, Belize, Dominica, Haiti, Jamaica, Saint Kitts and Nevis, Saint Lucia, Trinidad and Tobago due to the 2014-2016 drought.

TABLE 1: **SOCIO-ECONOMIC IMPACTS OF THE 2009-2010, 2014-2016 AND 2019-2020 DROUGHTS CONT'D**

SECTOR	DROUGHT IMPACT(S)
HEALTH	• *Outbreaks of water-borne disease* – In Jamaica, ingestion of unsafe water led to increased incidences of diarrhoea in 2010 (Cashman, 2014), while gastroenteritis was reported in Barbados due to improper water storage practices during the 2014-2016 drought.
ENERGY	• *Decrease in the contribution of hydropower to total electricity production.* In 2020, the Cumberland Hydroelectric Power Plant in St. Vincent and the Grenadines generated significantly lower than average electricity than expected for the dry period. The Richmond Hydroelectric Power Plant could only run one of two units, while the South Rivers Hydroelectric Power Plant experienced flow reductions due to drought conditions (personal communications, CWSA, May 2020).
TOURISM	• *Hotel cancellations* – The tourism industry was crippled by the 2014-2016 water crisis in Tobago, with many hotel cancellations due to water shortages. • *Negative tourist experience* – Tourists were affected by the sight and pungent smell of dying fish around New River, Orange Walk, Belize, where pollutant concentration increased due to low water levels (Trotman et al., 2021).



Disruption to Water Supply Due to Excessive Rainfall, Floods and Landslides

Extreme rainfall events often lead to floods, debris flows and landslides that can compromise dam and reservoir integrity and damage distribution pipelines, intake works, boreholes, and pump stations either directly through floods and landslides or indirectly through loss of power (Cashman, 2014). Extreme rainfall can also increase suspended sediment and nutrient loads and increase the risk of pollution adversely affecting water quality - reducing the capacity of the water sector to meet demand. For instance, in 2010, landslides due to the passage of Hurricane Tomas in Saint Lucia led to some 80% of the population having to cope with a very limited water supply (Cashman, 2014). Moreover, after the passage of Tropical Storm Erika in August 2015, water distribution infrastructure was severely disrupted, with water tanks having to be distributed to several communities across Dominica.

These extremes lead to a reduction in the design life of water networks, increases in non-revenue water, and an unreliable potable water supply. The distribution of potable water was especially critical amid the COVID-19 pandemic when Caribbean populations required access to essential water services to comply with hygiene protocols (Trotman et al., 2021; Cayetano, 2020).

Due to its inextricable relationship with other sectors, challenges with water availability due to drought or excessive rainfall often have severe cascading impacts on sectors that are key to the functioning of Caribbean societies. This makes the need to increase regional capacity to develop early warning information that can enhance resilience in the water sector against weather and climate-related risks urgent.







Early Warning Information for the Caribbean Water Sector

According to the United Nations Office for Disaster Risk Reduction (UNDRR), through its "Early Warnings for All" initiative, an effective early-warning system comprises four interrelated elements:

1. risk knowledge
2. detection, monitoring, analysis and forecasting
3. dissemination and communication, and
4. preparedness and response capability.

Such systems can be adapted to provide actionable information to the water sector to reduce the risk to production, transmission and distribution infrastructure.

The CIMH, in part through the Regional Climate Centre (RCC) for the Caribbean, produces a range of products and services designed to help the water sector mitigate and respond to adverse impacts.

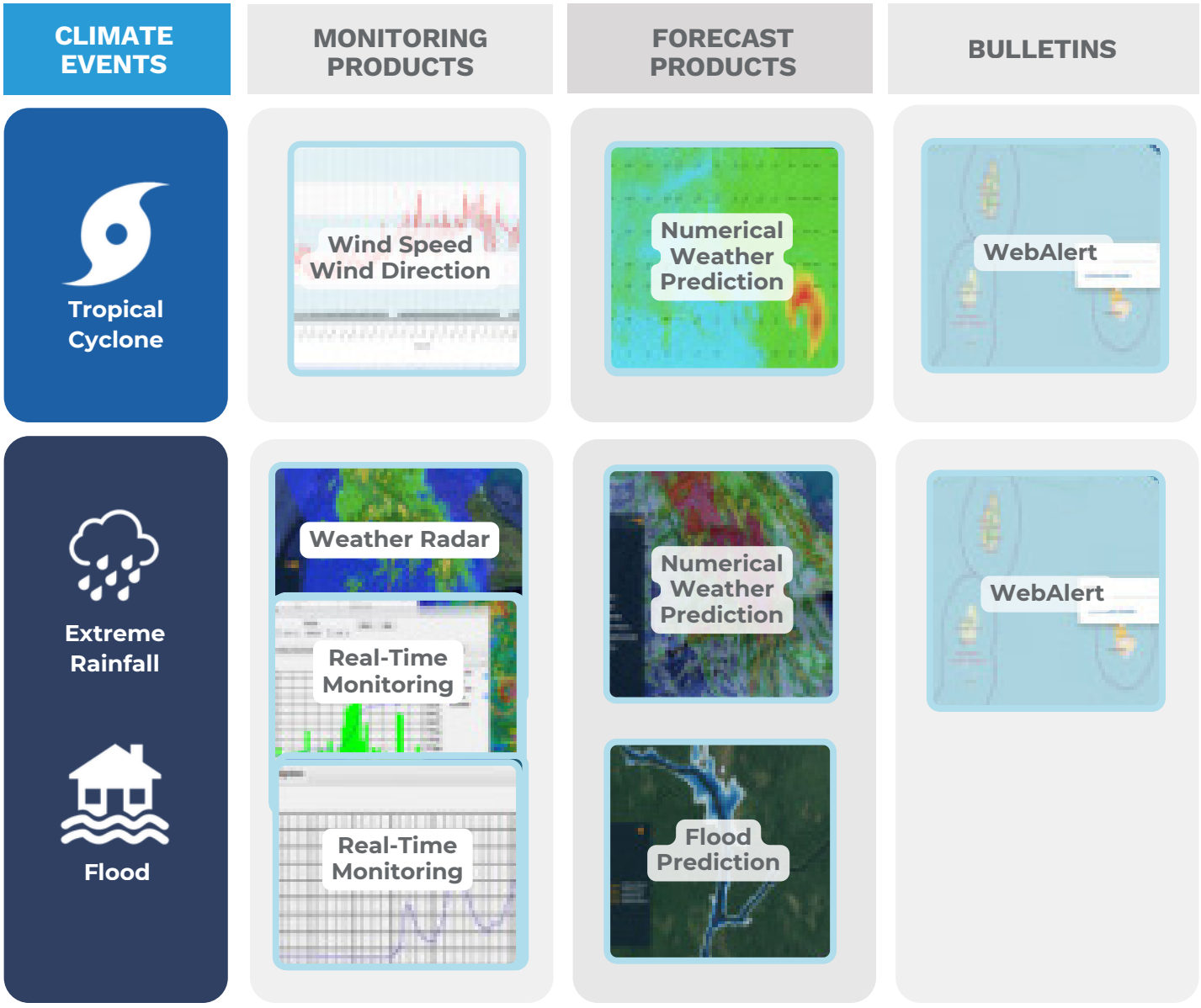
The RCC's products and services mainly focus on climate monitoring and seasonal/sub-seasonal forecasting. Monitoring products that reflect recent anomalies in rainfall, such as the Standardised Precipitation Index (SPI), can help water practitioners track the severity of rainfall deficits or excess. The Caribbean RCC also produces rainfall-related outlook products to help the water sector mitigate and respond to upcoming drought and extreme rainfall events at the seasonal climate timescale - 3 to 6 months in advance.

CLIMATE EVENTS	MONITORING PRODUCTS	FORECAST PRODUCTS	BULLETINS
Drought	SPI Monitor	The CariCOF Climate Outlook Newsletter	The Caribbean Drought Bulletin
	SPEI Monitor	The CariCOF Drought Outlook	
Dry Spell	CAROGEN Rainfall Accumulation Graphs	The CariCOF Dry Spells Outlook	
		The CariCOF Heat Outlook	
Wet Spell	SPI Monitor	The CariCOF Wet Spells Outlook	The CariCOF Climate Outlook Newsletter
	SPEI Monitor	Atlantic Hurricane Season Outlook	
Flood		CariCOF Flash Flood Potential Outlook	

National level information on tropical cyclones and severe weather systems is readily accessible through tropical storm watches, warnings, advisories and outlooks produced by the National Meteorological and Hydrological Service in each country.

The suite of operational weather, water and climate monitoring and forecast products and services covers the geographic Caribbean and is maintained by a large team of regional and national level experts who support the water sector in monitoring and predicting adverse impacts to infrastructure, water levels, production and delivery needs. All seasonal and sub-seasonal climate monitoring and forecast products are freely available on the Caribbean RCC website at http://rcc.cimh.edu.bb.

More broadly, the CIMH also provides services to support near real-time monitoring of the hydrological environment, impact-based forecasting and early warning. These services include the near real-time monitoring networks, prediction models and information provision illustrated below





Improving the Provision of Climate Information for Water Resources Management

Robust water resources assessments are problematic in many Caribbean countries due to the paucity of hydrological, weather and climate data at the watershed level (Cashman, 2014). An optimized observation network would enhance monitoring and assessments. Such a network may require an increase in the density of hydro-meteorological instruments where gaps exist, as well as a greater allocation of resources to support maintenance and sustainability across the region. Effective data management and dissemination is essential for the generation and provision of information. The incorporation of space-based and airborne technologies is attractive but can be prohibitively expensive.

The CIMH has supported several initiatives that have increased the density of hydro-meteorological stations and have integrated the use of remote sensing technologies into decision-making workflows. Data from these networks are used to support risk identification, detection and monitoring and dissemination of warnings to the public during periods of adverse weather conditions.

The WMO Hydrological Observing System (WHOS) facilitates hydrological data sharing. It is a multi-scale (local, national, regional and global) registry of hydrological data and

information services catalogued using the standards and procedures developed by the Open Geospatial Consortium (OGC) and the WMO.

The CIMH is also actively investigating how data from its network of hydro-meteorological instruments can be supplemented by remotely sensed data to further increase the resolution of weather and climate information. To increase drought mitigation and response, the CIMH launched the Caribbean Drought and Precipitation Monitoring Network (CDPMN) in 2009 under the 2007-2012 Caribbean Water Initiative (CARIWIN). The CPDMN monitors drought and general precipitation at national and regional scales using monthly rainfall and temperature anomalies, the Standardised Precipitation Index (SPI), and the Standardised Precipitation-Evapotranspiration Index (SPEI). The Caribbean RCC continues to improve the range and quality of climate information to benefit Caribbean water through incremental R&D activities.

The CIMH also manages a number of platforms that support water resources management. These include the Caribbean Dewetra Platform and the recently developed the Caribbean Rainfall Intensity-Duration-Frequency Data Explorer. In particular, the data explorer, developed through an engagement with the Caribbean Development Bank (CDB) provides access to historic and climate adapted IDF curve data typically used to design flood mitigation measures. Additionally, recent investments in remote sensing applications have proven beneficial.

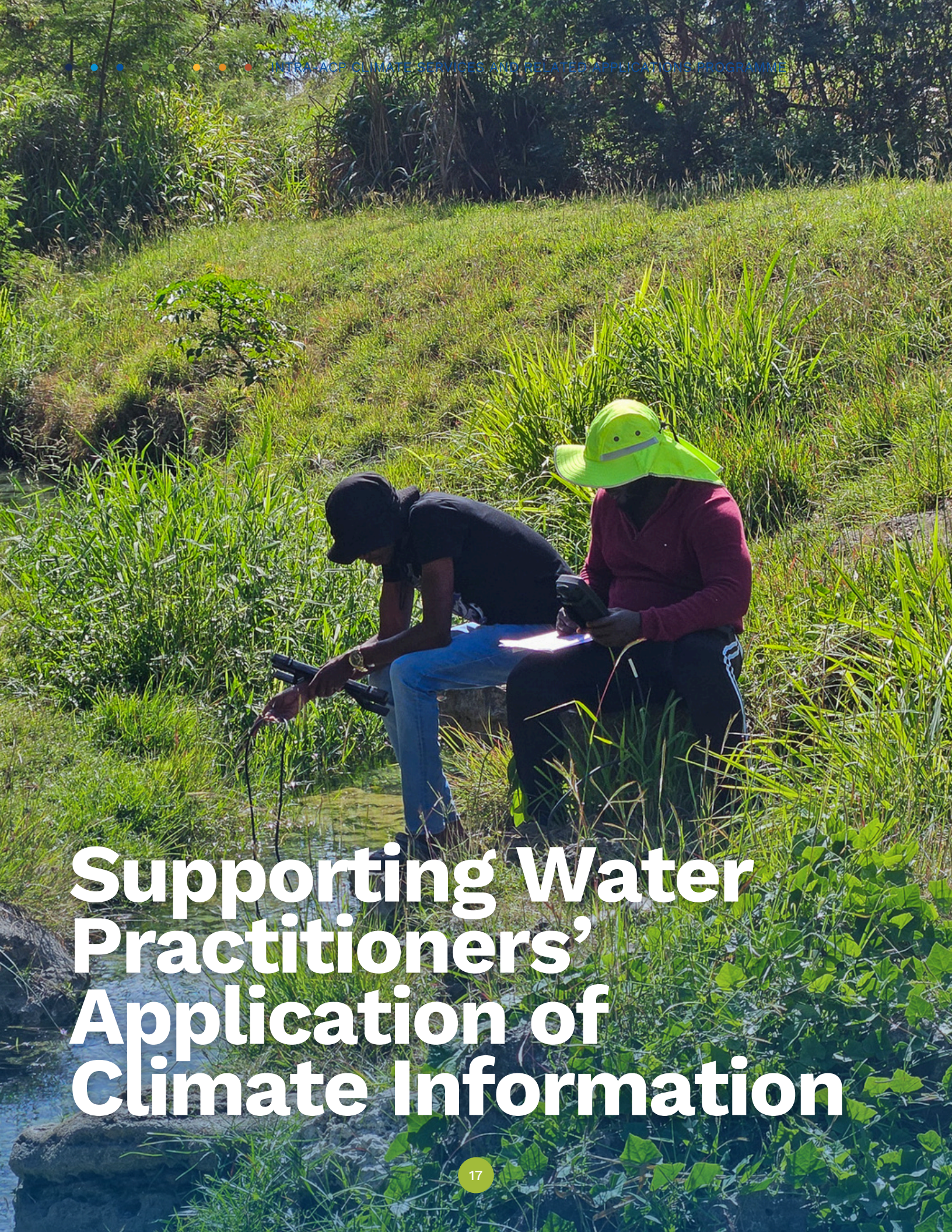


The Caribbean Dewetra Platform

The Caribbean Dewetra Platform is an online, spatio-temporal, decision making, data fusion tool capable of seamlessly integrating evolving hazard data, socio-economic and vulnerability information. Within the platform ground- and space-based near real-time hydro-meteorological observations in addition to numerical weather prediction model outputs are presented and manipulated as spatial layers.

Country specific information such as, but not limited to, ground elevations, slopes, watershed extents, flood and landslide hazard maps, population demographics and geo-located critical infrastructure are integrated within the application. The application is maintained by staff at the CIMH and used to support impact-based forecasting and early warning.

Access to the Caribbean Dewetra Platform is freely available to Member States of the Caribbean Meteorological Organisation (CMO).



Supporting Water Practitioners' Application of Climate Information

Supporting Water Practitioners' Application of Climate Information

In an era of changing climate and increased weather, hydrological and climate risk, having reliable advice on the timing, duration and intensity of drought and extreme rainfall events is becoming increasingly important.

To aid in decision-making in the water sector, the WMO encourages Members to appoint a Hydrological Adviser to advise on WMO activities in operational hydrology and their application to water management. The Hydrological Adviser should preferably be the head of the respective National Hydrological Service or other national hydrological agency and should be consulted on national water resource management and policy issues.

Given the size and scale of the challenge, building resilience to extreme weather, hydrological and climate events requires collaboration across a range of sectors. National coordination mechanisms and user interface platforms are essential avenues for supporting practitioner decision-making. Newer coordination and interface platforms such as National Committees for Climate Services provide a space for regular interaction and intersectoral planning between the National Meteorological and Hydrological Services, water managers and all climate-sensitive sectors. The formation of these Committees is increasingly important in mounting a coherent response to extreme weather, climate variability and change. However, few such Committees currently exist.

Moreover, National Flood and Drought Management Plans contribute to enhanced risk knowledge and provide a roadmap for multi-sectoral action in support of water resources management. More work is needed to expand the development and enhancement of National Flood and Drought Management Plans to all Caribbean countries.

The management of weather and climate in the water sector is crucial to the sustainable development of Caribbean economies. Risk management can be enhanced by improving the provision and application of weather, water and climate information. The CIMH and its network of NMHSs invite policymakers responsible for water management to partner with us to support the advancement of weather, hydrological and climate services for Caribbean water.

This publication was jointly produced by the Caribbean Institute for Meteorology and Hydrology (CIMH) and the Caribbean Waste Water Association (CWWA) under the Intra-ACP Climate Services and Related Applications (ClimSA) Programme, with support from the European Union.

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The Caribbean Regional Climate Centre (Caribbean RCC)

Regional Climate Centres (RCCs) designated by the World Meteorological Organization (WMO) are centres of excellence dedicated to providing regional climate products and services. Their mission is to enhance the capacity of national meteorological services in each region, enabling them to deliver high quality climate information and prediction products to national users. RCCs produce mandatory regional products, including climate data sets, climate monitoring tools and long-range forecasts, which serve as critical regional inputs for National Meteorological and Hydrological Services (NMHS) climate operations. RCCs also deliver training and capacity building for the NMHSs in their region.

The Caribbean RCC at the CIMH leads the development and distribution of the operational climate products, services and programmes delivered by CIMH including but not limited to long range (seasonal) forecasts, regional climate monitoring, the Caribbean Climate Outlook Forum (CariCOF), the Caribbean Drought and Precipitation Monitoring Network (CDPMN), and sectoral focused climate bulletins co-produced with regional sector agencies. The RCC also provides training on the development and delivery of climate products and services to national level providers of climate information, as well as offer training to national and regional stakeholders on how to effectively interpret climate information and integrate it in their planning and decision-making activities.



About the Intra-ACP ClimSA Programme

The Intra-ACP Climate Services and Related Applications (ClimSA) Programme is a four-year initiative funded by the European Union (EU) through the 11th European Development Fund (EDF) and implemented in the Caribbean by the Caribbean Institute for Meteorology and Hydrology (CIMH). It forms part of a global effort led by the Organisation of African, Caribbean and Pacific States (OACPS) to strengthen the provision and use of climate information services across ACP regions.

In the Caribbean, the programme seeks to enhance the entire climate services value chain through technical and financial assistance, infrastructure development, and capacity building. The programme's goal is to improve access to and application of climate information to support informed decision-making at all levels, enabling more effective adaptation measures and fostering a climate-resilient Caribbean.

Sixteen OACPS Member States benefit from this initiative through regional capacity building, institutional strengthening at CIMH, and the sharing of lessons and results from three pilot sectors:

- Agriculture and Food Security Sector in Guyana
- Water Sector in Jamaica
- Health Sector in Dominica

Main Objectives

- Strengthen interaction between users, researchers, and climate service providers in the Caribbean.
- Ensure effective provision of climate services at regional and national levels.
- Improve access to climate information and enhance regional capacity to generate and apply climate data.
- Mainstream climate-informed decision-making into regional and national policy processes.
- Build resilience in key socio-economic sectors affected by climate variability and change.

This publication was produced under the Intra-ACP Climate Services and Related Applications (ClimSA) Programme, implemented by the Caribbean Institute for Meteorology and Hydrology (CIMH). This programme is supported by the European Union under the 11th European Development Fund (EDF) Intra-ACP ClimSA Programme, and the Organisation of African, Caribbean and Pacific States (OACPS).

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