EXECUTIVE SUMMARY

In the Caribbean, weather and climate events recurrently impact economic performance, productivity, livelihoods and quality of life. The record-breaking 2017 hurricane season stands as one of several recent examples that strongly underscore the economic, physical and social vulnerability of Caribbean nations to climate-related phenomena. Evidence-based and proactive decision-making will be fundamental to the transformation process from vulnerable to resilient Caribbean societies.

This State of the Caribbean Climate (SOCC) Report was prepared to strengthen the strategic planning and decision-making processes that will be required to accelerate resilience-building efforts in the Caribbean, specifically within the 19 Borrowing Member Countries (BMCs) of the Caribbean Development Bank (CDB). By providing significant climate data, information, analysis and references, distributed across 10 chapters, the SOCC Report is expected to become the premise for actionable recommendations that will support climate proofing at national and regional levels.

The structure and content of this report facilitate provision and analysis of climate data and information in a manner that takes cognizance of the similarities and differences among Caribbean nations. Chapters 1 and 2 provide the introductory background and methods and sources of data collection, respectively. Chapters 3 to 6 describe historical and future climate by focusing on key variables, e.g., temperature and rainfall, as well as extreme climate phenomena such as droughts, floods, sea level rise and hurricanes. The impacts of these climate variables and extremes on key sectors have been summarized in Chapter 7. Chapter 8 details the Caribbean approach and experience in developing climate services for improving national and regional response mechanisms. An overview of the key report findings and recommendations for the way forward are set forth in Chapter 9, and a list of all the references (by chapter) used in the preparation of this document is presented in Chapter 10.

While this report provides a significant repository of climate data and information (some of which have been summarized in the table below), there are a number of critical data-related gaps and challenges that need to be addressed as the region seeks to employ evidence-based approaches to decision-making. These data challenges are linked to inadequate coverage of weather and climatological stations that will (i) facilitate analysis at sectoral, national and regional scales (ii) enable automatic reporting, and (iii) improve continuous monitoring and analysis of key variables for sufficiently long timescales (greater than 30 years). Also to be addressed in support of better decision-making are (i) inadequate data collection and monitoring systems at the sectoral level that limit the understanding of climate-sectoral linkages (ii) the need for higher resolution modelling outputs as well as more impacts-based modelling, and (iii) coordination and capacity challenges that have reduced the effectiveness of climate action in the region.

Table ES 1: Summary of Climate Trends and Projections for the Caribbean

HISTORICAL TREND[2]	PROJECTION[3]
RAINFALL	
» Caribbean region has a defined dry (December to April) and wet (May to November) season. » Caribbean countries can be divided into six rainfall zones, based on the pattern of rainfall received. » Central Caribbean (Zones 3 and 4) receives smaller rainfall amounts (2-17 mm/month) while the far western and southern Caribbean (Zones 1 and 6) receive rainfall amounts ranging from 2 to 27 mm/month. » More than 70% of the rainfall occurs in the wet season for each zone. » In the long-term historical record (1900-2014), the Caribbean has not gotten wetter or drier (no significant observed linear trend). » Decadal variations account for 7% of the observed variability in Caribbean rainfall. Year-to-year (interannual) variations account for up to 91%. » The number of consecutive dry days is increasing, as well as the amount of rainfall during rainfall events.	» The Caribbean as a whole will gradually dry through to the end of the century. Drying is expected to be less in the far north Caribbean and more in the south and southeast. » Global Climate Models (GCMs) suggest for the central and southern Caribbean basin, drying up to 20 per cent for annual rainfall, while Regional Climate Model (RCM) based projections suggest up to 25 and 35 per cent less rainfall by the end of the century » GCMs suggest that mid-2020s will see up to 2% less rainfall in the annual mean. By the 2050s, the region is in the mean up to 6% drier, and by the end of century, the region may be up to 17% drier. » The Caribbean drying trend is likely driven by drying in the late wet season (September-November). » Dry season rainfall generally shows small increases or no change. » RCMs suggest sub-regional variation in projections with some parts of the region being more significantly impacted by drier conditions than others. A general pattern is for Belize in the far west Caribbean (Zone 1) and the Lesser Antilles and southern Caribbean (Zones 5 and 6) to be the most severely impacted once drying has begun, as well as the central Caribbean (Zone 4) to a lesser extent. » Changes to mean annual rainfall in the far north and north Caribbean (Zones 2 and 3) may suggest slightly wetter conditions through to mid-century, which change to drier conditions by the end of century. It is important to note however, that even for the far north Caribbean, the rainy seasons are projected to dry from as early as the 2020s. » Small to large increases in consecutive dry days are projected across the region.
AIR TEMPERATURES	
» Most of the variability observed (~65%) in temperature in the Caribbean is due to a significant upward (linear) trend. » Increase in temperature in Caribbean is consistent with global warming trend. » There is an increasing trend in very warm days and nights for the Caribbean as a whole.	» The Caribbean as a whole will gradually warm through to the end of the century. » Minimum, maximum and mean temperatures increase irrespective of scenario through the end of the century. » The mean temperature increase (in °C) from GCMs will be 0.48-0.56°C by the 2020s; 0.65-0.84°C by the 2030s, 0.86°-1.50°C by the 2050s, and 0.83-3.05°C by the end of the century with respect to a 1986-2005 baseline over all four RCPs. » RCMs suggest higher magnitude increases for the downscaled grid boxes - up to 4°C by end of century. » Temperature increases across all seasons of the year. » There are regional variations in warming evident in the RCM results. The far western Caribbean (Zone 1) and the southern Caribbean (Zone 6) show slightly higher warming than the rest of the region. » Projections based on statistical downscaling show an increase for both warm days and warm nights by the end of the century - warm days ranged between 51 and 251 days, and warm nights between 24 and 360 days for RCP 8.5. » The trend is for a decrease in both cool days and nights. The range for cool days was between 1 and 41 days, and between 1 and 32 days for cool nights for the end of century under RCP 8.5.

2 Historical trends are based on observations made over 1900-2014.

3 GCM-generated projections are relative to a 1986-2005 baseline, RCM-generated projections are relative to a 1961-1990 baseline.

HISTORICAL TREND[2]	PROJECTION[3]
SEA SURFACE TEMPERATURES	
» Range from 25°C to 30°C over the period of the year and follows a normal distribution pattern, with the lower temperatures in December/January and the highest temperatures in July.	» Recent warming trend in SSTs will continue in the future. » Under a business-as-usual scenario, SSTs increase by 1.76 ± 0.39°C per century in the wider Caribbean. » The mean annual SST range (~ 3.3°C) currently observed in the Caribbean Sea is projected to contract to 2.9°C in the 2030s, and to 2.3°C in the 2090s. By the end of the century, years of coolest projected SSTs fall within the range of the warmest years in the present.
SEA LEVELS	
» There is a general increasing trend in the sea level of the Caribbean region: » A regional rate of increase of 1.8 ± 0.1 mm/year between 1950 and 2009. » Higher rate of increase in later years: 1.7 ± 1.3 mm/year between 1993 and 2010. » Caribbean Sea level changes are near the global mean. » Larger sea level increases observed for post 2000 period during which hurricane intensity and sea level interannual variability have both increased.	» For the Caribbean, the combined range for projected SLR spans 0.26-0.82 m by 2100 relative to 1986-2005 levels. The range is 0.17-0.38 for 2046 – 2065. Other recent studies suggest an upper limit for the Caribbean of up to 1.5 m under RCP8.5. » Regional variation in SLR is small with the north Caribbean tending to have slighter higher projected values than the southern Caribbean. By the end of the century, sea level rise is projected to reach or exceed 1m across the Caribbean.
HURRICANES	
» Significant increase in frequency and duration of Atlantic hurricanes since 1995. » Increase in category 4 and 5 hurricanes; rainfall intensity, ass°Ciated peak wind intensities, mean rainfall for same period.	» No change or slight decrease in frequency of hurricanes. » Shift toward stronger storms by the end of the century as measured by maximum wind speed increases of +2 to +11%. » +20% to +30% increase in rainfall rates for the model hurricane's inner core. Smaller increase (~10%) at radii of 200 km or larger. » An 80% increase in the frequency of Saffir-Simpson category 4 and 5 Atlantic hurricanes over the next 80 years using the A1B scenario.

As the region considers how to respond in light of the implications of the key findings of this report and the uncertainty of future climate threats, there are three simple key messages or guiding principles that should undergird decision-making.

KEY MESSAGE 1: PLAN FOR THE CURRENT CLIMATE – BUT BE GUIDED BY LESSONS OF THE PAST.

It is important that the Caribbean region learns the lessons of the past and use them to guide current and future decision-making processes. Chapters 3 and 4 present the historical (long-term) characterization of Caribbean climate, by focusing on variables such as rainfall and temperature (sea surface and air) and climate extremes such as droughts, floods, sea level rise and hurricanes. The region has struggled with addressing these climate-related threats in an anticipatory manner, and this has increased individual and collective vulnerability. One key example of this is the frequently reactive manner in which slow-onset events such as droughts are addressed. Despite significant efforts such as work led by the Caribbean Institute for Meteorology and Hydrology (CIMH) to improve early warning for drought (see Chapter 8), there has been limited implementation of major long-term policy and other adaptation initiatives by decisionmakers to reduce drought's damaging impacts. The lessons of the past dictate that we can no longer afford to wait until an event happens, or is about to happen, before action is taken to deal with climate hazards. It is important that planning and decision-making efforts are (i) proactive, (ii) not curtailed or stalled once the threat is deemed to be past, and (iii) guided by past lessons and available expertise.

KEY MESSAGE 2: PLAN FOR THE FUTURE CLIMATE – BUT DO IT COLLABORATIVELY.

Prioritized collective action, coordinated across sectoral, national and regional levels, will be critical for successful decision-making. The projections for the Caribbean (presented in Chapter 5) are for rising sea levels, hotter temperatures, more variable rainfall with increased drying, increased sea surface temperatures, and more intense hurricanes. These projections, especially in light of the recent extremes discussed in Chapter 6 and the climate impacts in Chapter 7, call for urgent and coordinated action even while the region tries to grapple with existing threats. The climate-related phenomena that so drastically affect Caribbean countries are not locally derived, and as such, our response mechanisms must also be regionally driven and locally applied. The small size of Caribbean islands is one factor pointing to the need to work together to strengthen regional response mechanisms. In identifying those prioritized actions that the Caribbean should take, consideration should be given to (i) the social and economic costs of inaction or delayed action against the value to be derived from resilience efforts, (ii) the levels of resilience that can sustainably be targeted, and (iii) the systems that will need to be in place to support the transition to a more resilient Caribbean.

KEY MESSAGE 3: PRIORITIZE HARNESSING AND ENHANCING REGIONAL STRENGTHS AND EXPERTISE IN SUPPORT OF IMPROVED DECISION-MAKING

Chapter 8 presents an overview of climate services in the region, as well as national and regional mechanisms for supporting same. These efforts, which stand as key examples of regional strengths, have been led by the CIMH in collaboration with a consortium of regional partners. There is significant scope for bolstering these and similar services as well as the implementing institutions so that critical data, information, products and tools to improve decision-making are readily available to end users. As the region tackles climate change, identification and exploitation of regional strengths and opportunities, such as those for integrated, interdisciplinary and targeted research and development programmes as well as climate products and services, must play a substantial role in decision-making.