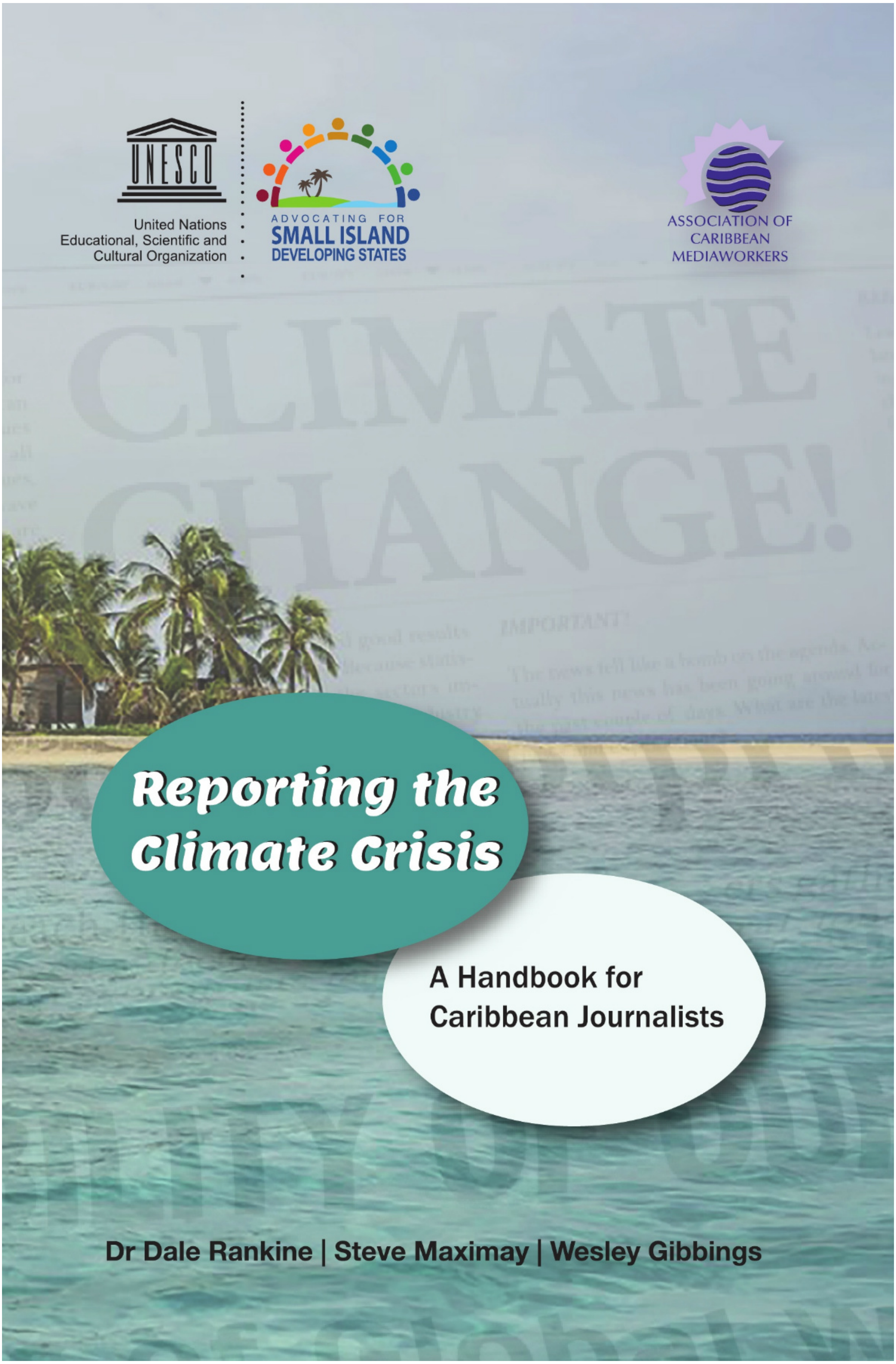

UNESCO
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ADVOCATING FOR
SMALL ISLAND
DEVELOPING STATES

ASSOCIATION OF
CARIBBEAN
MEDIAWORKERS

Reporting the Climate Crisis

A Handbook for Caribbean Journalists

Dr Dale Rankine | Steve Maximay | Wesley Gibbings

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ADVOCATING FOR SMALL ISLAND DEVELOPING STATES

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FOREWORD

There is empirical evidence that rising sea levels, changing precipitation patterns and more frequent and intense extreme weather events are effects of climate change which increasingly undermine the livelihoods of people in Caribbean Small Island Development States (SIDS).

This direct impact of climate change on our daily lives underscores the urgency to mobilise people in the Caribbean to intensify climate action. Against this background, the Caribbean media sector plays a vital role in bringing the essential conversation on climate change to the attention of the Caribbean public, while providing reliable evidence and informing on concrete areas of individual and collective action.

More than ever, it is the responsibility of journalists to make sure that findings which emanate from the science community gain traction in the broader public and that climate change gets the coverage it deserves. Moreover, accurate reporting on climate action is also vital for ensuring accountability of governments and private companies. Besides being a major source of trusted information, high quality media coverage is also essential to convey messages on adaptation plans to key audiences, especially to marginalized groups, to ensure nobody is left behind.

The United Nations Educational, Scientific and Cultural Organisation (UNESCO) works at the intersection of climate change and media development through quality journalist education which is tailor-made to the local context. Responding to the special development challenges of Caribbean SIDS, one strategic action set out in our sub-regional strategy, dubbed Special Initiative for the Caribbean, focuses on enhancing journalists' knowledge and skills to explain and disseminate information on measures to mitigate and adapt to climate change and increase resilience.

What is the scientific consensus on climate change? What are actual effects of climate change in Caribbean SIDS? And what are the main implications when covering climate change in news stories?
These are some of the major questions broached by this Handbook on Climate Change for the Caribbean, jointly published by the UNESCO Cluster Office for the Caribbean and the Association of Caribbean Media Workers, as outcome of a series of workshops which took place across the Caribbean in 2019.

The purpose of this publication is to improve the quality and quantity of climate change coverage across the Caribbean. With this handbook, we hope to equip journalists with the necessary information on climate change in the sub-region and propose possible strategies to convey the magnitude of the problem based on the needs of the Caribbean audience.

On behalf of the UNESCO Cluster Office for the Caribbean, I am pleased to invite you to make use of this handbook in order to raise awareness and accelerate individual and collective urgent action on climate change. It is the decisions and actions that we take today which will prevent harm from future generations and ensure climate resilience and the sustainable development of Caribbean SIDS.

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INTRODUCTION

The title of this publication echoes a sobering reality for the entire Caribbean. Climate change poses an existential threat to the region, and calls for both risk and crisis management.

In this regard, competent journalistic coverage of the science, politics, public policy, economics, and broad developmental challenges of climate change in the Caribbean is needed. This can play a strong role in providing the region with an opportunity to better come to terms with and take action on an unmatched, overarching area of public concern.

The Caribbean as a region is extremely climate sensitive because most (if not all) sectors on which development depends are themselves reliant on favourable climate. The region has experienced the adverse impacts of a number of severe weather events, notably hurricanes and droughts, and these have served to sharpen the focus on climate-related events.

While attributing one event to climate change is not possible, tracking trends over a sustained period can be done. Early indications are that the severity and frequency of these types of events are among the early manifestations of climate change. This in turn has raised awareness of the historical and projected impacts of climate change.

Globally, the impact of this phenomenon on media practice has revolutionised journalistic approaches to cross-cutting issues. Traditional notions of newsroom "beats" are being re-examined and news organisations are being forced to consider more rigorous coverage of increasingly evident impacts of changing climate on all areas of life in various regions.

The very practice of journalism, through its gate-keeping functions (bearing in mind the competitive claims of social media), include de-constructing and validating contexts, opinions and angles. These cannot be considered to be of neutral value within the information marketplace.

Sustained coverage of the science and public policy dimensions of climate change also has the potential to re-calibrate news agendas, re-frame public discourse, and address looming apathy on the issue. In the process, journalists and their news organisations will require access to more wholesome, user-friendly material for application as empirical contexts in the development of stories.

Emerging issues include developments in key sectors relating to energy security, climate financing, peril insurance, sustainable tourism, and food and nutrition security and production. This list is not exhaustive. Other concerns abound for community development, health (human and environmental), recreation, water, biodiversity, and the management of waste.
It is conceivable that should the media – in all its old and new manifestations – succeed in confronting all these issues, the extent to which it does so will likely determine how societies meet the informational demands of one of the most critical challenges of our time.

Among the changing dimensions is the fact that the subject has been acknowledged as being global in scope. Crucially, though, the states least culpable for the causes of climate change – and least capable of coping – will bear a disproportionately large share of the adverse impacts.

The boundaries for coverage expand far and wide, and in the case of small island states such as those in the Caribbean, reflect units of technical measurement that exceed individual landmass impacts. Simply put, islands' exclusive economic zones comprise marine areas (extending 200 miles from the coast) that are several times larger than individual land masses.

Climate change science also focuses on phenomena that span much longer periods of time than traditional news cycles. If such journalism is to be done well, it will be challenged through the structure and style of journalistic treatment.

Coverage of climate change also holds entry-points to the key issues of health, social development, economic sustainability and the power dynamics of Caribbean populations. As a basis for better understanding the phenomenon and initiating public policy and action, there is also an additional and increasing reliance on scientific principles and practices.

Meeting the challenge of a journalistic mandate on climate change thus requires greater competency to understand scientific nuance and debate, greater vigilance to monitor related public policy, and stronger interpretive skills to process and present vital connections.

The practice of climate-aware journalism is influenced by factors related to scientific methodology, technological applications, shifting policy orientations, linguistic shifts and the need for proportionality when delivering arguments not always rooted in reliable science.

A volume such as this, then, must necessarily address these vagaries of public discourse, even as it presents journalists and interested parties. It employs a framework for improved storytelling and narrative structures, while providing reliable, trust-worthy platforms to disseminate news, information and a diversity of opinions, analyses and other subjective content that populate mass media eco-systems.

The concerns addressed here revolve around growing global consensus on the anthropogenic (man-made) nature of climate change – a fundamental precept of current learnings – including known hazards such as hydro-meteorological events, droughts and consequential fires, floods and landslips. There is thus a requirement to extend coverage from phenomenon to disaster; socio-economic impacts; and regional and international responses.

This approach encourages greater emphasis on sustained versus episodic coverage of climate issues, especially since scientific observations focus more heavily on trends than on events. It also promotes awareness of the more substantial journalistic opportunities that reside behind official pronouncements, scientific discovery, and contentious debates.

Importantly, there is an often-ignored press freedom component of climate-aware journalism. This most recently came to the fore during international discussions on the United Nations-brokered Sustainable Development Goals (SDGs).

SDG 13 on Climate Action unambiguously acknowledges humanity's contribution to the problem and prescribes an increase in public awareness. It further emphasises the need to "convey urgency to world leaders so we can begin combating climate change before it is too late". It is, however, far more difficult to negotiate facilitative mechanisms that permit this.

Climate change gains relevance through all 17 goals but it is SDG 16 on Peace and Justice, specifically Target 16.10, which has relevance to the work of the media and information sector. Target 16.10 calls on countries to "ensure public access to information and protect fundamental freedoms, in accordance with national legislation and international agreements".

In so doing, the global community essentially has expressed a desire to provide the means by which official information remains freely available as a right and not as a privilege, to help shape popular expression on global developmental goals.

This publication seeks to present to journalists and other interested parties the science and public policy elements of the climate change story.

PREAMBLE – KEY DEFINITIONS

Climate Change: Distinct (irreversible) changes in measures of climate (rainfall, temperature, wind speed, etc.) lasting for a long period of time (at least thirty years to centuries).

Climate Change vs Climate Crisis:

Climate change refers to the long-term and permanent changes in climate, as manifested in different parameters such as rainfall, temperature, winds and cloudiness. The primary focus of discussion is on changes induced by human activities, primarily burning fossil fuels.

Climate crisis is a term used to describe the imminent threat posed by global warming and climate change to Earth and to urge more aggressive actions to reduce the causes of this warming. Studies have shown using the term climate crisis evokes a stronger emotional response by conveying the sense of urgency.

Mitigation: Actions taken to reduce the sources of greenhouse gases that cause global warming or to increase the sinks (anything that absorbs more carbon than it releases). Mitigation actions include switching from fossil fuel-based sources of energy to renewable ones (such as solar and wind energy). Planting trees and forest maintenance are also effective actions.

Adaptation: Actions taken to cope with the adverse impacts of climate change or to take advantage of any benefits derived therefrom.

El Niño vs La Niña: El Niño is an above normal warming of the tropical

Pacific Ocean (along the western coast of South America). It occurs at a frequency of 3-7 years, commencing near Christmas and is associated with drought conditions in the Caribbean. La Niña is the reverse – abnormally cooler ocean conditions and higher than normal rainfall in the Caribbean.

Weather: the state of the atmosphere at a specific time and place

Climate: A measure of the average pattern of variation of a meteorological variable e.g. rainfall or temperature over a period of time (usually at least 30 years) for a particular region.

Climate Variability: Variations in climate on shorter time scales. There are two modes of variability – inter-annual and decadal.

Inter-Annual: the year-to-year changes in climate, such as those driven by the El Niño phenomenon. El Niño adversely affects Caribbean rainfall in the year of onset (causing drought conditions) and increases rainfall in the early rainfall season in the year following (El Niño +1 year).

Decadal Variability: refers to changes that occur over longer time scales- typically every ten years or groups of decades.

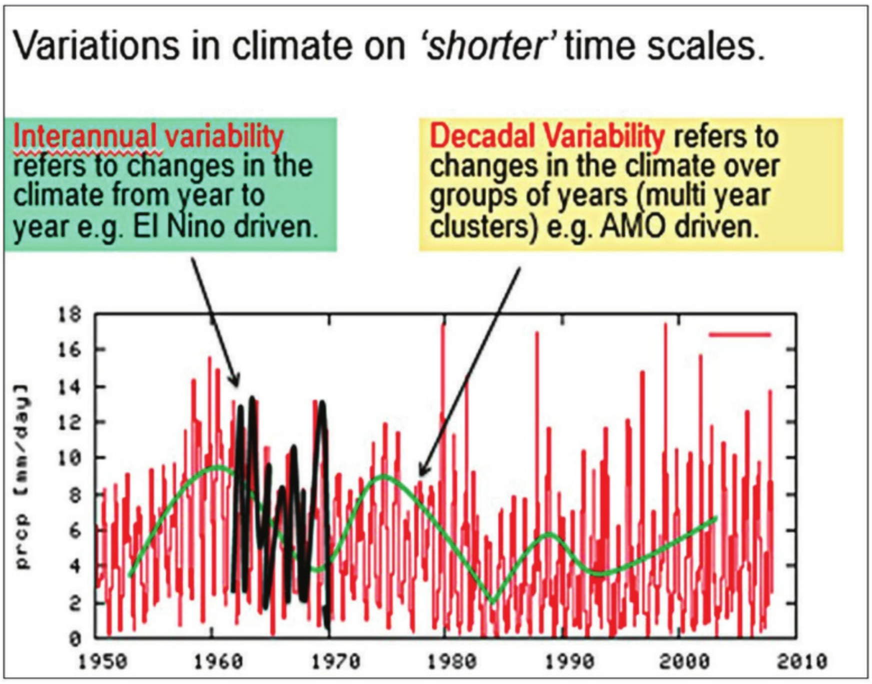


Figure 1. Climate Variability in rainfall: inter-annual and decadal variability. (*Source: Taylor 2018.)*

CHAPTER 1.
Global Consensus – **Causes & Manifestations**

Causes of Climate Change: Climate may change due to a number of factors. These include:

- Natural Variations due to the earth's revolution: This affects the primary driver of the earth's climate system – the amount of solar radiation received on the surface.

- Volcanic eruptions (global cooling): Major volcanic eruptions can release large volumes of volcanic clouds comprising gas and solids high enough to block portions of the sun's energy (heat) from reaching the earth's surface. For example, when Mount Pinatubo erupted in the Philippines on June 15, 1991, an estimated 20 million tons of sulphur dioxide and ash particles blasted more than 20 kilometres (12 miles) high into the atmosphere.

The eruption caused widespread destruction and loss of human life. Gases and solids injected into the stratosphere circled the globe for three weeks. Volcanic eruptions of this magnitude can impact global climate, reducing the amount of solar radiation reaching the earth's surface, lowering temperatures in the lower atmosphere (the troposphere), and changing atmospheric circulation patterns. (https://earthobservatory.nasa.gov/features/Volcano)

- The Human Impact (anthropogenic issues): The earth's atmosphere keeps the planet at a habitable (mean) temperature of 15°C (59°F), by trapping and redirecting heat towards the surface. This warming effect is called the atmospheric greenhouse effect, because the gases play a similar role to heat trapping glass in a greenhouse. Human activities, primarily through burning fossil fuels, have increased markedly the concentration of these greenhouse gases (GHGs) in the atmosphere.

As industrialisation increases and global population rises, so does the need for energy (which primarily comes from fossil fuels), thus an attendant increase in GHGs. The net effect is an unequivocal increase in global surface temperatures (global warming), which has a number of manifestations on the climate system. There is a clear nexus between increases in GHGs (reckoned in total equivalent CO2 emissions) and temperature increases.

Annual anthropogenic GHG emissions have increased between 1970 and 2010, with this increase directly coming from energy supply, industry, transport, and buildings sectors. GHG emission levels and sources are different across income brackets, with shifts from Agriculture, Forestry and Land Use (AFOLU) being the greatest source in low income economies and energy being the greatest source in high income economies.

Emission levels are lowest in low income economies and highest in high income economies. Globally, economic and population growth continue to be the most important drivers of CO2 emission increases from fossil fuel combustion. The contribution of population growth between 2000 and 2010 remained roughly identical to the previous three decades, while the contribution of economic growth has risen sharply. Without additional efforts to reduce GHG emissions beyond those in place today, emissions growth is expected to persist, driven by growth in global population and economic activities (Taylor 2018).

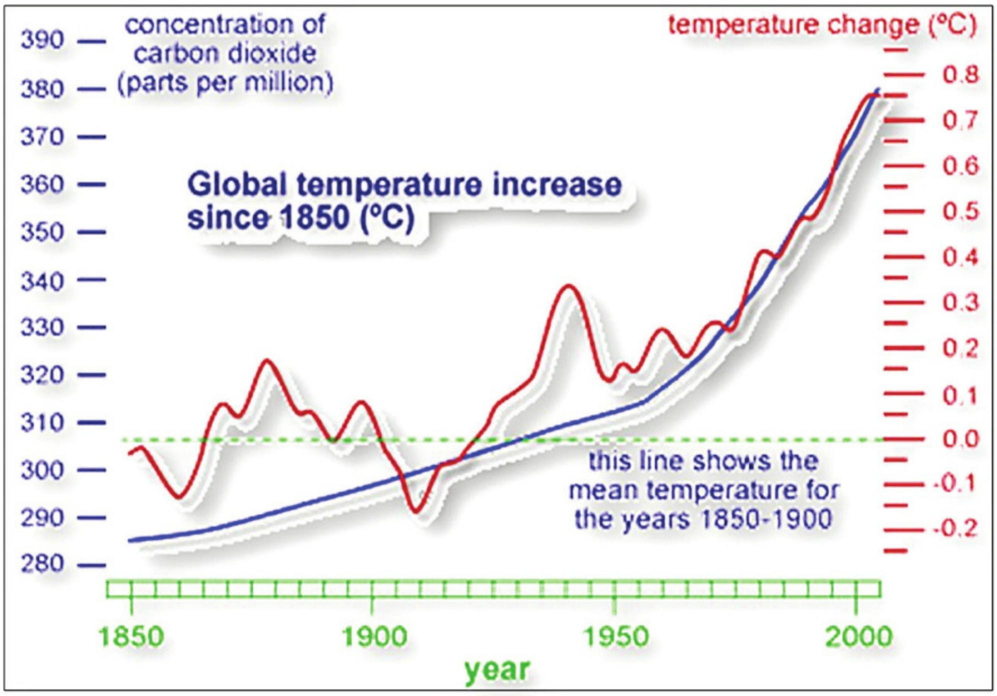
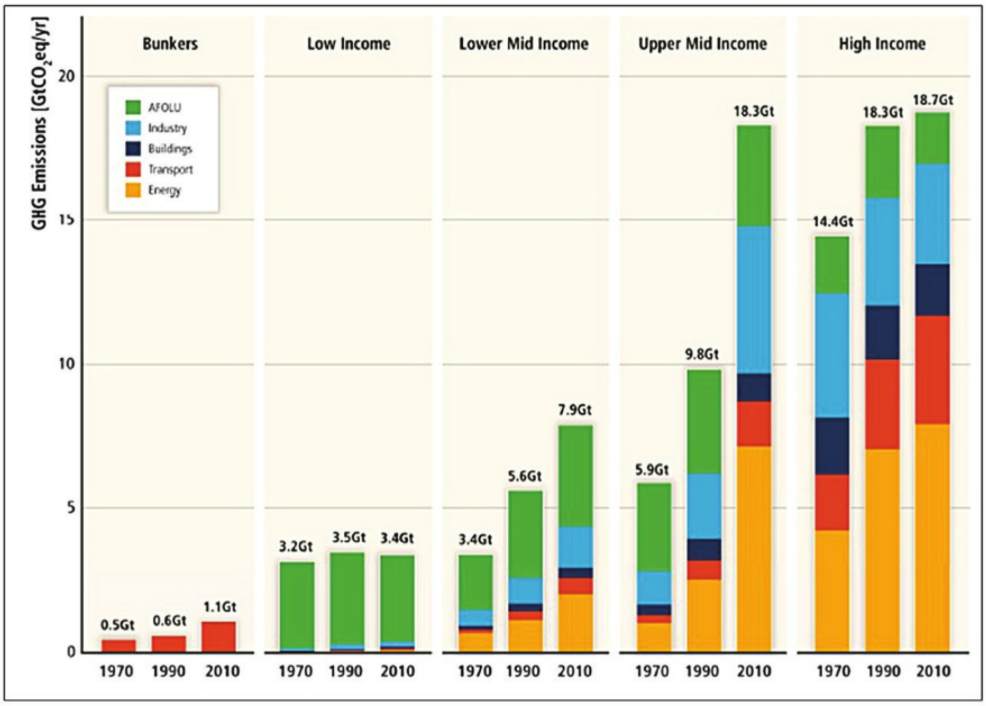


Figure 2. (a) The CO2-Temperature nexus: as carbon dioxide (CO2) concentration increased in the atmosphere (blue line) over time, global temperature (red line) has increased as well. (b). Activities driving increases in GHGs: Increases in GHGs (1970-2010) are directly linked to energy supply, industry, transport, and buildings sectors. Emission levels and sources differ across income brackets (Agriculture, Forestry and land use (AFLOU dominates low income countries while a shift to energy-based industries and sectors is keenly noted in high income countries. Economic and population growth are the most significant drivers of CO2 emissions. **(Source: IPCC AR5)**



THE GLOBAL WARNING – THE EVIDENCE OF CHANGE

An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.

There are six primary manifestations of climate change. This section will provide details and graphics of the changes in a logical manner. It will set the stage for the sequel – The Caribbean Impacts – - which follow.

- Unequivocal warming of the earth's climate system: Human-induced warming reached approximately 1°C (likely between 0.8°C and 1.2°C) above pre-industrial (prior to 1850) levels in 2017, increasing at 0.2°C (likely between 0.1°C and 0.3°C) per decade (high confidence).

Global warming is defined in this report as an increase in combined surface air and sea surface temperatures averaged over the globe and over a 30-year period (IPCC 2018). Figure 3 shows some unprecedented facts about this warming:

It exceeds any similar event in the past 2000 years.

It impacts the vast majority of the world, (98% of the globe) and is significantly more widespread than even the "Medieval Warm Period (AD 950-AD1250), which increased temperatures across 40% of Earth's surface.

It significantly exceeds natural variability, emphasising the human (anthropogenic) influence on global warming.

Marked increase in ocean heat: Ocean heat dominates the increase in energy. On the global scale ocean warming is largest near the surface and the upper 75m warmed by a mean of 0.11°C (0.09°C to 0.13°C) per decade, over the period 1971-2010.

Melting of sea ice and snow cover: Over the last two decades, the Greenland and Antarctic Ice sheets have been losing mass. Glaciers have continued to shrink almost worldwide, and Artic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent.

Sea level rise: The rate of sea level rise has steadily been increasing. Over the period 1901 to 2010, global mean sea levels rose by 0.19m (0.17m to 0.21m). The average mean rate of global sea level rise was 1.7mm/year between 1901 and 2010 but has accelerated ove time reaching 2.0mm/year and 3.2mm/year between 1971 and 2010.

Precipitation changes: Precipitation is any product of the condensation of atmospheric water vapour that falls under gravity. The main forms of precipitation include drizzle, rain, sleet, snow, and hail. There have been changes in precipitation across the globe, especially since 1951. Changes are not, however, homogenous – some regions have received higher amounts, while decreases have been noted in others.

Increase in extreme weather events: The number of cold nights has decreased and the number of warm days has increased. The frequency of heatwaves has increased, as well as heavy precipitation events. Intense hurricanes have also been noted, especially since 1950.

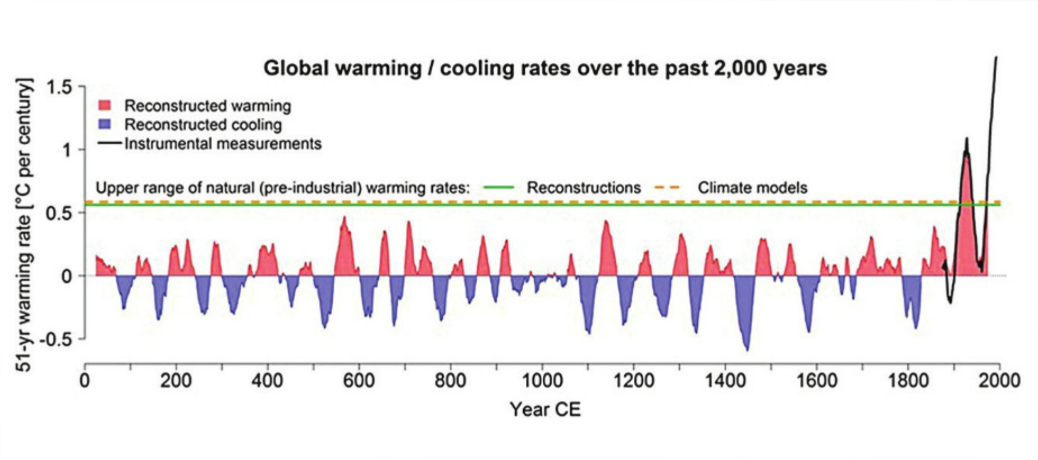


Figure 3. Warming and Cooling rates for last 2000 years; rates of warming since 1900 have exceeded all prior periods. Reconstructed warming (red), reconstructed cooling (blue), Instrumental records (black). University of Bern https://www.bbc.com/news/science-environment-49086783- Accessed September 30, 2019

CHAPTER 2.
Caribbean Climate: **The Past, Present & Future**

In this section, information will be provided at the scale of the Caribbean in two parts as listed below. This allows for a convenient assessment of past trends and changes in the context of those that are projected for the future. More importantly, it provides baseline conditions against which future projected changes can be benchmarked and compared.

For the purposes of this document, the Caribbean is defined as the Small Island and Low-lying Coastal Developing States (SIDS) of the region.

Figure 4. The Caribbean Region as referenced by this report

Past Trends and Changes in Caribbean Climate

Rainfall pattern and changes

In general, the Caribbean has a wet season that runs from May to November and a dry season that runs from December to April. Rainfall during the wet season accounts for up to 90% of total rainfall in most islands of the region. For most of the region, the wet season has a distinctive bi-modal pattern, meaning a rainfall season that has two distinct peaks. One peak occurs in May or June and another between September and December.

These two peaks are divided by a period of comparatively lower rainfall, termed the Mid-Summer Drought (MSD) (July-August), which allows for a convenient division of the rainfall into an early (May-June) and late (September-November) rainfall season (see figure 5). Overall, the central Caribbean receives less rainfall than the western and southern Caribbean. There has been a slight reduction in Caribbean rainfall over the last 100 years, but high rainfall variability from year to year (and between decades) has been a far more dominant feature of the region's rainfall trend.

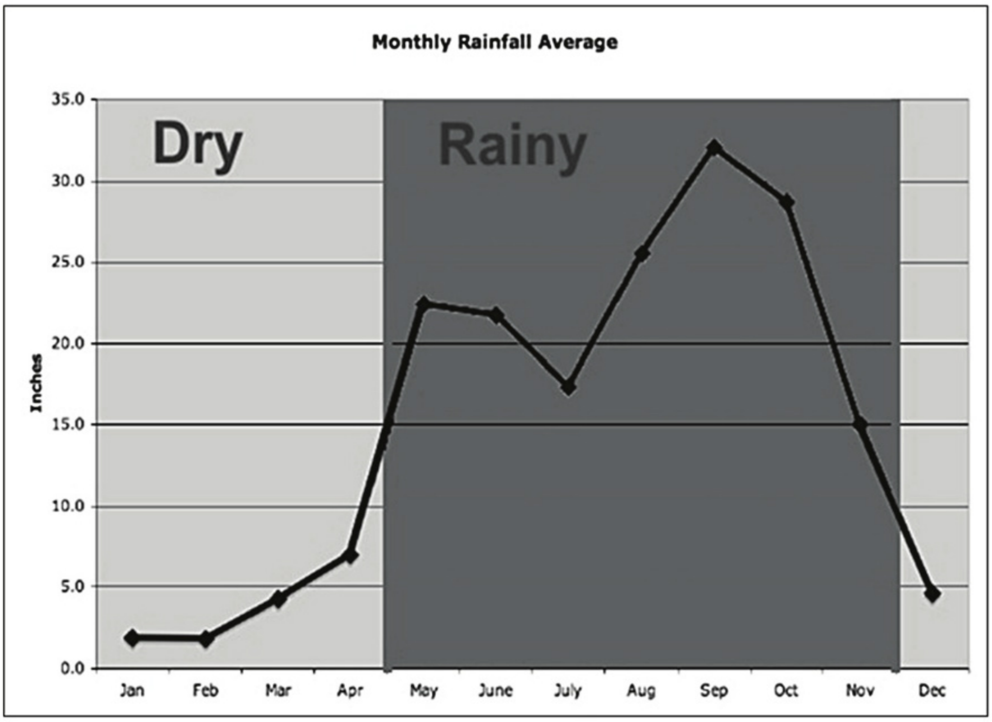


Figure 5. Pattern of mean monthly rainfall in the Caribbean.
Source (ntsavanna.com)

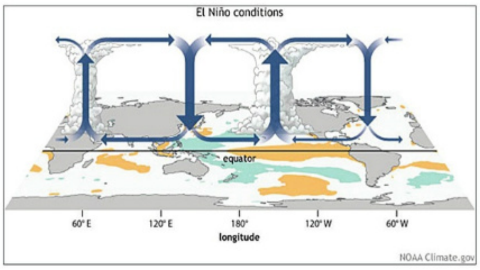
Understanding the ENSO and its impacts on Caribbean rainfall

One of the chief drivers of the inter-annual (year-to-year) variability in Caribbean rainfall is a phenomenon known as the El Niño Southern Oscillation (commonly abbreviated as ENSO and pronounced en-so). El Niño and La Niña are opposite phases of a natural climate pattern across the tropical Pacific Ocean that swings back and forth every 3-7 years on average. Together, the El Niño and La Niña are called ENSO. The El Niño (warm phase) and the La Niña (cool phase) lead to significant differences in several weather parameters, including rainfall. (NOAA, climate.gov).

During El Niño (warm phase), the surface winds across the entire tropical Pacific are weaker than usual. Ocean temperatures especially along the western coast of South America are warmer than average. The warming commences around December in the year of onset (close to Christmas, hence the term El Niño which is the Spanish for the Christ Child).

In this phase, rising air motion (which is linked to storms and rainfall) increases over the central or eastern Pacific, and much flooding and rainfall increases over western South America. By contrast, sinking air motion occurs over the Caribbean and this suppresses the formation of rain clouds and leads to major droughts in the region. So, during an El Niño, rainfall is generally lower than normal and hurricane formation low.

The year after onset of the El Niño phenomenon also tends to be wetter in the Caribbean, especially in the early (May-June) rainfall season.
During the La Niña (cool phase), the opposite occurs. The surface winds across the entire tropical Pacific are stronger than usual, and most of the tropical Pacific Ocean is cooler than average. Rising air motion now occurs over the Caribbean and this promotes the formation of storms and hurricanes and rainfall is usually higher than normal. Sinking motion air occurs over the Central and Eastern Pacific and rainfall over that region reduces.



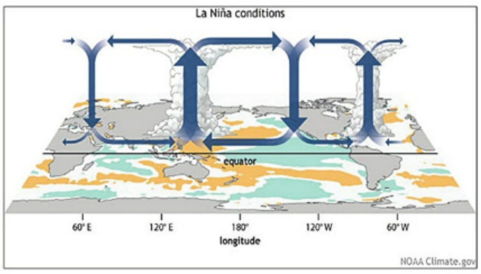


Figure 6. Generalised air circulation and weather conditions associated with (a) El Niño and (b) La Niña conditions

Temperature trends and changes

Air temperatures in the Caribbean generally range between 22°C and 28°C. Temperatures are coolest between December and February, with high temperatures in other months, generally peaking in August.

Temperatures in the region over the period 1900-2014 have increased consistently. The average temperature increase is 0.09°C per decade and this is consistent with the assessment of many studies (e.g., Jones et al. 2014; Stephenson et al. 2012). Night-time temperatures have been increasing at a faster rate (0.28°C per decade) compared to day time temperatures (0.19°C) (Stephenson et al. 2014). There has also been an increase in the number of warm days and warm nights (Stephenson et al. 2014).

Sea surface temperatures (SST) across the region are generally in the range 25°C to 29°C with warmest temperatures in the summer but for most of the year, temperatures are above 27.5°C (see figure 7a). This temperature is a threshold for the formation of storms and hurricanes, so storm activity can occur for a major portion of the year. SSTs over the period 1993-2008 have been increasing at a rate of 0.1-0.4°C per decade.

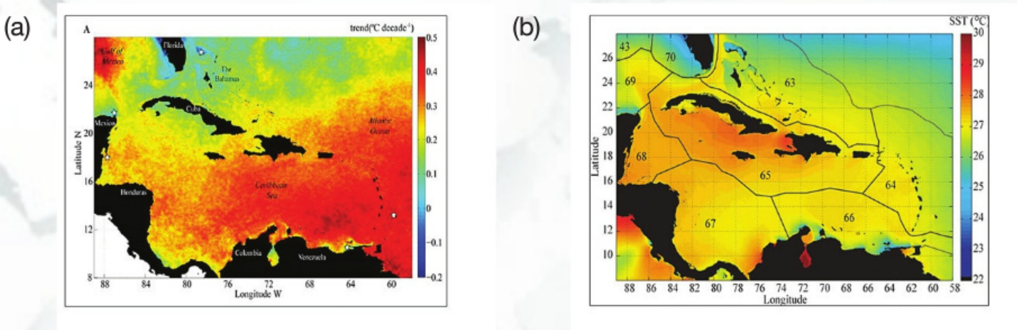


Figure 7. (a) Average sea surface temperatures in the Caribbean (°C) and (b). mean rate of change in SST 1993-2008. Source: researchgate.net

Sea Level Rise

Sea levels in the Caribbean have been rising at about 1.8mm/year over the period 1950-2009 but higher rates have been reported in more recent times (post 1993), with a rate of over 3.5 mm/year since. Though all islands have experienced increases in sea level, the rate of increase is not uniform across the region (see figure 8). High sea levels increase the likelihood of flooding and storm surge, especially during the passage of hurricanes and other tropical storms. A significant portion of Caribbean infrastructure and investment (air and sea ports, roads, bridges, key buildings) and human settlements are located within coastal zones.

Further, most socio economic activities are conducted within or close to flood plains. In this regard, sea level rise could seriously imperil the viability of Caribbean states in the long term.

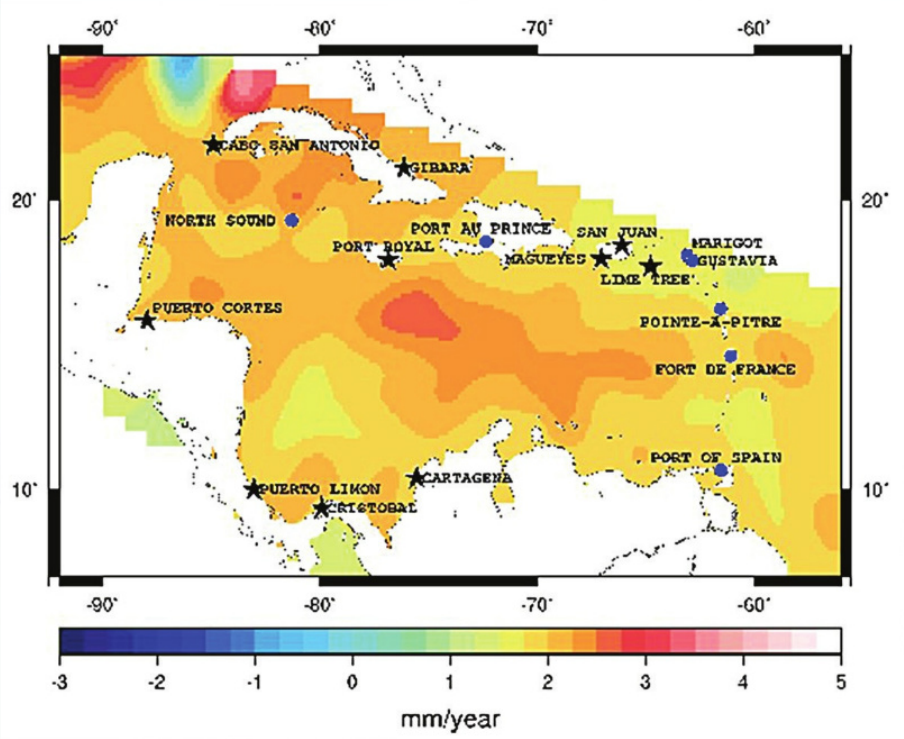


Figure 8. Sea level rise (mm/year) in the Caribbean Mean Reconstruction Seal Level (MRESL)1950- 2009. Palanisamy et al. (2012).

Climate Extremes: Droughts, Floods and Hurricanes

Hurricanes

The hurricane season in the Caribbean runs from June 1 to November 30, with the period of greatest activity generally between August and October. Records suggest there has been an increase in storm activity since 1980 and a marked increase in the number of hurricanes and especially intensity (categories 4 and 5) since 1995. Among the most destructive storms to affect the Caribbean are Hurricane Ivan (2004), Irma and Maria (2017) and most recently, Dorian (2019). Hurricane Ivan led to catastrophic damage in Grenada and high economic losses (over 90% of GDP).

The 2017 North Atlantic (and Caribbean) hurricane season was unprecedented, with several major hurricanes that affected many small island states in the Caribbean, resulting in 200 deaths and losses and damage amounting to billions of dollars (WMO, 2018).

The World Meteorological Organization (WMO) Statement on the State of the Global Climate in 2017 noted that there were three exceptionally destructive hurricanes that occurred in rapid succession in the Caribbean basin in late August and September: Harvey, which formed in August, with Irma and Maria following in early and mid-September respectively (see figure 9). Hurricane Irma's initial landfall, at near-peak intensity, led to extreme damage across numerous Caribbean islands, most significantly on Barbuda, which experienced near-total destruction. The island had to be totally evacuated, which was a first for any Caribbean territory.

Other islands to experience major damage included: Anguilla, Saint Martin/Sint Maarten, Saint Kitts and Nevis, the Turks and Caicos Islands, the Virgin Islands and the southern Bahamas. Irma went on to track along the northern coast of Cuba, leading to extensive damage there (WMO, 2018).

Hurricane Maria made initial landfall on Dominica at near-peak intensity, making it the first category 5 hurricane to strike the island, leading to major destruction there. The World Bank estimates Dominica's total damages and losses from the hurricane at US$ 1.3 billion or 224% of its Gross Domestic Product (GDP). This island also experienced a significant loss of life, with 31 confirmed deaths and an almost equal number of people missing, out of a population of fewer than 80,000. The storm weakened slightly but was still a Category 4 hurricane when it reached Puerto Rico. Maria triggered widespread and severe damage on Puerto Rico from wind, flooding and landslides (WMO 2018).

Floods

The Caribbean as a region is very prone to flooding given its vulnerability to the adverse impacts of hurricanes and storms. One recent Caribbean study (Burgess et al 2018) showed that there were at least 370 climate-related hazards and of this number, riverine flooding accounted for 59 (or 15.9%). Flood occurrence is not evenly distributed across the Caribbean. In general, the islands of the Greater Antilles experience more flood events, and Haiti has had the highest recurrence of flooding.

Droughts

The climate sensitivity of the Caribbean is clearly borne out by the over-reliance on rainfall. A number of the key socioeconomic sectors, including agriculture are almost totally rain-fed with no supplemental sources of water.

During drought periods, when the amount of rainfall is below normal, there are significant disruptions. Most drought events in the Caribbean have been linked to the ENSO and date as far back as 1957. Recent drought events in 1994, 1997-1998, 2009, and 2013-2016 have been linked to the ENSO. This is an example of a slow-onset climate event whose impact is not always immediately felt.

Droughts are not spatially distributed in an even way. The northern Caribbean seems least prone to drought while the southern and eastern regions have experienced more intense droughts in the 1960s, 1970s and also in the1990s. The three-year drought experienced in 2013-2016 was one of the most intense and prolonged and affected almost the entire region.

The Future Climate of the Caribbean

The future climate of the Caribbean will likely be very different from what is being currently experienced. In order to arrive at plausible future climates, computer models are used in concert with climate scenarios to make projections of how different climate parameters will change in the future.

There has been much progress in the refinement of scale of climate models. Previously, global climate models were used to make projections, but these were not able to capture the specific details of small islands that would provide accurate information on Caribbean climate and weather.

For example, one grid box in a global climate model could cover hundreds of kilometres (nearly the whole Caribbean) and at best only the larger islands would be featured. Regional climate models now have the ability to zoom in and to provide more details. These models have much higher resolution allowing for parameters to be examined at much smaller scales (e.g. below 20 km). This allows for both inter and intra-island projections of changes in climate and a more accurate premise on which to infer future climate. One general rule that is used to make projections (irrespective of the model used) is:

Model + Scenario = Future Climate

Definition of terms:

Model: Computer based tools used to analyse and represent climate, based on mathematical equations and representation of atmospheric physics.

Scenario: Storylines of how future economic development could progress and the attendant emissions or representative concentration pathways (RCPs) that they could follow.

Future: A range of possible climate alternatives is projected, based on climate models and scenarios.

Rainfall Projections

Rainfall in the region is expected to become more variable, with drying trends towards the mid and end of the 21st century. Mean rainfall is expected to be up to 30% below current values with the principal drying occurring in the late rainfall season (September to October). Irrespective of the climate scenario used, a clear drying is projected for the region. The agreement between models gives high confidence that this projection is most likely to occur.

Temperature Projections

Temperatures are expected to continue increasing in the Caribbean. The rate of increase is expected to be greater than the present, with end of century projections suggesting an increase of between 1°C and 4°C above current levels. The IPCC 2018 Special 1.5 Report has demonstrated that a temperature rise of 1.5°C above pre-industrial levels represents a critical threshold for Small Island Developing States and Low-lying Coastal States (SIDS), and especially for Caribbean SIDS. For example, Lallo et al. (2018) showed that much higher levels of heat stress will be faced by livestock once this critical threshold is reached, with animals experiencing in excess of 7-9 months of severe heat stress.

Sea Level Rise (SLR)

Higher sea levels are projected for the Caribbean. Two main factors will contribute to this accelerated rate: (i) The melting of glaciers and snow cover in temperate countries, resulting in higher volumes of ocean water, and (ii) the thermal expansion of water as sea surface temperatures increase.

Projected increases in sea levels are estimated at 1-2 metres by the end of the century depending on the Representative Concentration Pathway (RCP) that materialises. Accelerated sea level rise will have devastating consequences on the Caribbean. For example, one study (CARICOM & UNDP 2010) has concluded that the impacts from a 2-metre sea level rise on Antigua could result in the following:

- A 5% loss in land area
- A 6% displacement of people
- Up to 50% damage or loss to power installations
- Loss or damage to 18% of tourism resorts
- Total (100%) loss or damage to airports and sea port structures
- Loss of 6% of roads

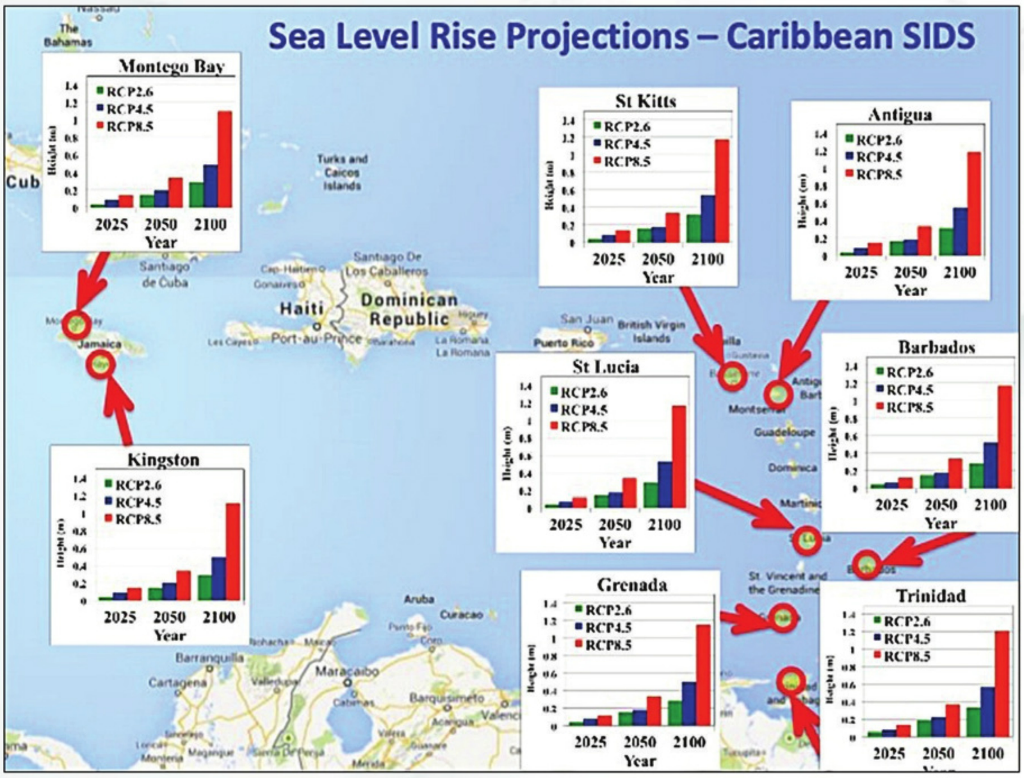
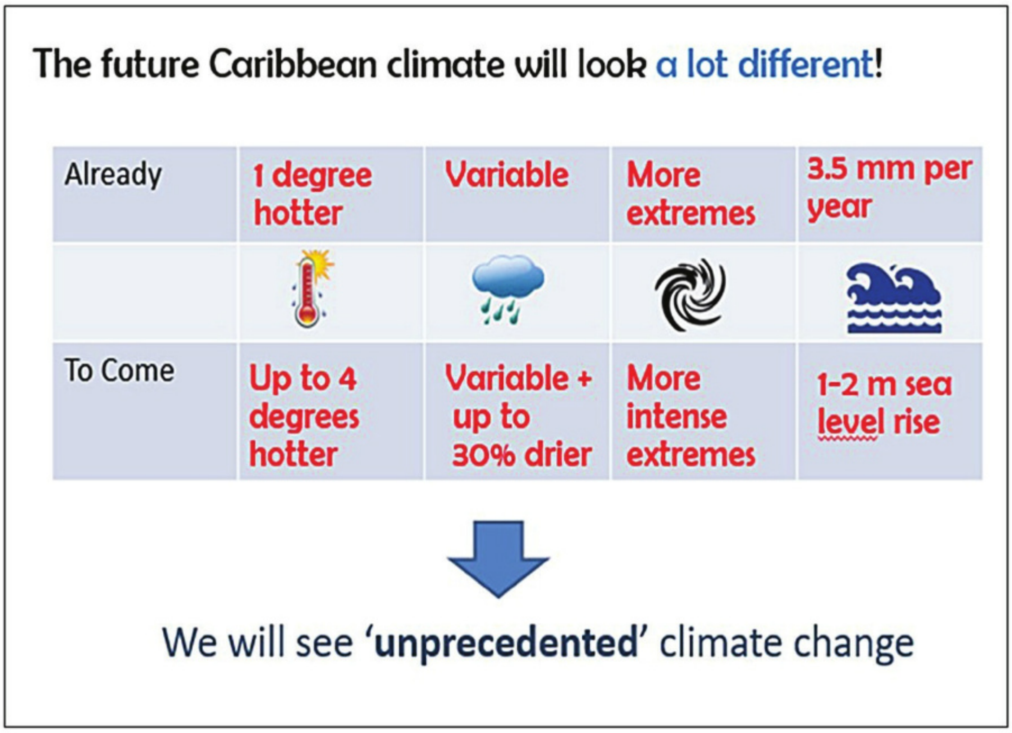


Figure 10. Estimated rise in sea level associated with different climate scenarios. Representative concentration Pathway (RCP)- RCP 2.6 (Low Scenario-Green); RCP4.5 (Medium Scenario-Blue), RCP 8.5 High Scenario-Red)
Source: (Nurse 2015)

Climate Extremes: Droughts, Floods and Hurricanes

Higher variability of rainfall suggests that droughts and floods will be more intense. With lower rainfall projected, it is anticipated that drought conditions could be prolonged when compared to current conditions. Heavy rainfall over a shorter period of time, will likely cause higher incidence of flooding.

There is no consensus on the number of hurricanes that could be experienced in the future in the Caribbean. Some models have suggested there could be an increase while others project a decrease (the latter being linked to potential impacts of more intense ENSO). There is unanimous agreement that the number of intense hurricanes (Category 3 or higher) will increase in a warmer climate. This bears serious implications for the region, especially given recent experiences.



The future Caribbean climate will look a lot different!

Already	1 degree hotter	Variable	More extremes	3.5 mm per year
To Come	Up to 4 degrees hotter	Variable + up to 30% drier	More intense extremes	1-2 m sea level rise

We will see 'unprecedented' climate change

Figure 11. Summary of anticipated changes in Caribbean Climate
Source: (Taylor, 2018)

CHAPTER 3.

Coverage of Hazards – From Phenomena to Disasters

Discussions about climate change initially centred on whether it existed. With the passage of time and the manifestation of its scientifically-observed impacts, there has been greater recognition of a causative relationship between climate change and the hazards that have emerged.

Over the years, climate change has become synonymous with disasters. Exposure to the hazards associated with climate change does not necessarily translate into disasters.

DRM/DRR: Modern approaches to Disaster Risk

Disaster risk management (DRM) is the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses (UN Office of Disaster Risk Reduction).

Disaster Risk Reduction (DRR) is the concept and practice of reducing disaster through systematic efforts to analyse the exposures of disasters.

From Hyogo to Sendai: A New Action Plan for Resilience
The Hyogo Framework was the global blueprint for disaster risk reduction efforts between 2005 and 2015. Its goal was to substantially reduce disaster losses by 2015 - in lives, and in the social, economic, and environmental assets of communities and countries.

Ten years after the Hyogo Framework became the global blueprint for disaster risk reduction, much has changed about the way the world approaches disaster risk reduction. The focus now is not only on disaster preparedness, but on building resilience by helping communities mitigate the inevitable disasters they will face before, during, and after disasters strike.

The third UN World Conference on Disaster Risk Reduction in Sendai, Japan set out to renew commitments to reduce the risk of disasters at home and abroad. The result was the Sendai Framework for Disaster Risk Reduction 2015-2030. Establishing ambitious targets, this framework includes goals of reducing mortality, minimising economic and infrastructure losses, and getting countries to commit to disaster risk reduction strategies.

Three themes were front and centre at Sendai and are critical to making the world a safer place by 2030.

Building Resilience

Reducing disaster risk is not enough. We must build resilience by helping communities build the capacity to bounce back from the inevitable shocks they face. We must move from a preoccupation with mega-disasters, like tsunamis and earthquakes, to also deal with chronic shocks and stresses – from frequent floods and droughts to rapid urbanisation and chronic food insecurity – that keep communities locked in a cycle of crisis. To do so, we have to break down silos, bringing the humanitarian and development communities together to invest in long-term solutions that build resilience among the world's most vulnerable.

Many governments and donors at Sendai recognised the importance of this, and as a result, the Sendai Framework elevates resilience as a priority.

Promoting Local Solutions

Locally-driven solutions are crucial for lessening disaster risks. Many civil society organisations were present at Sendai, sharing how their communities have been affected by disasters. They were also part of the solution to building preparedness and resilience at the local level. They will continue to play a critical role in holding governments accountable for their commitments.

Fostering Inclusion

During a disaster, women, youth, the elderly and people with disabilities have different needs and often fare worse than others. These critical stakeholders are included in the Sendai Framework. When we invest in disaster risk reduction worldwide, we must make sure no community is left behind, and that we are taking the unique needs and strengths of each community into account.

Without a doubt, reducing the risk of disasters and building resilience is critical to protecting the gains made in sustainable development. Sendai reminds us that we must make risk-informed investments if we are to achieve the goal of ending extreme poverty.
The main differences between the Sendai and Hyogo Frameworks is that Sendai focuses on disaster risks while Hyogo focus on disaster losses. Focus on disaster risks puts more effort to reduce the size of disasters. Disaster losses focuses more on minimising the impacts of disasters.

Sendai focuses more on the means of implementation or “the how”: how are we going to stop or prevent those natural hazard issues. For Hyogo it is the “what”: understanding the risks and what can be done in response to these risks. Sendai and Hyogo call for collaboration of people at the local level, fostering partnership with technology and the private sector to share good practices and support globally.

Both frameworks focus on reducing mortality from global disasters. They also focus on multi-stakeholder and inclusive approaches regarding natural hazards. Technically, Hyogo and Sendai have the same goals and to emphasise on this Sendai added 7 Global targets to measure DRR (disaster risk reduction) in its framework.

The Sendai framework uses some parts of the Hyogo Framework as its basis.

CHAPTER 4.
Socio-Economic Impact

Sensitivity of Caribbean Economies to Climate Change
Inherent Vulnerabilities to Climate Change

There are a number of inherent circumstances that make the Caribbean particularly vulnerable to climate change. Among the chief ones are:

• Limited physical size and isolation of islands – This effectively reduces some adaptation options to climate change and sea level rise. Retreat is often difficult, and in some cases, entire islands could be eliminated with abandonment as the only option. Protection costs for human settlements and critical infrastructure are too burdensome for individual states.

• Generally limited natural resources – Many resources are already heavily stressed from unsustainable human activities. Financial and human resources are also inadequate.

• High susceptibility to natural hazards – Islands are in the path usually followed by tropical cyclones.
Other hazards include earthquakes, tsunamis and volcanic eruptions, which can exacerbate climate hazards.
Economy-wide Impact
This is especially important given that most key infrastructure (tourism, transport, communications) and major economic activities are concentrated within coastal zones and, in some cases, low-lying floodplains. Lack of planning policies and/or failure to enact such policies can lead to large expanses of unplanned developments.

• Low economic resilience – This is due to the extreme openness of small economies, limited financial resources, and high sensitivity to external market shocks over which Caribbean SIDS exert little or no control.

• Generally high population densities – In some cases, high population densities are also compounded by high population growth rates. Often, large population settlements are located within coastal areas where they are very susceptible to flooding and storm surge. The prospect of sea level rise thus poses a serious threat for these coastal populations and the supporting infrastructure.

- Frequently poorly developed infrastructure – Most major state infrastructure does not include climate change considerations into the design. This usually renders it less resilient to severe weather events.

- Inadequate insurance coverage – Organisations and individuals alike often experience difficulty in securing requisite levels of insurance or re-insurance due to the perceived vulnerability to natural hazards.

Besides these, sea level rise bears other potential consequences such as coastal erosion and land loss, flooding, increased soil salinity and intrusion of saltwater into groundwater aquifers. The quantity and quality of available freshwater supplies can affect agricultural production and human health. Similarly, changes in sea surface temperature (SST), ocean circulation and upwelling could affect marine organisms such as corals, sea grasses, and fish stocks (IPCC, 2001a).

Society-wide/social impacts

In 2019 the International Labour Organisation published a report titled: "Working on a warmer planet: The impact of heat stress on labour productivity and decent work", in which it claims that even if the rise in temperature were limited to 1.5 degrees, by the year 2030, climate change will cause losses in productivity reaching 2.2% of all the working hours, every year. This is equivalent to 80 million full-time jobs or to $2,400 billion dollars.

The sector expected to be worst affected is agriculture, projected to account for 60% of the damage. The construction sector is projected to account for 19%. Other sectors that are most at risk are environmental goods and services, refuse collection, emergency and repair work, transport, tourism, sports and some forms of industrial work.

The socio-economic impacts of climate change are likely to be greatest in communities that face other stresses. For example, poor communities are vulnerable to extreme weather events, and are likely to be especially affected by climate change. In general, however, other changes (e.g., demographic and technological) are likely to have a greater effect on human society than climate change. On the other hand, major ("non-marginal") impacts could occur with abrupt changes in natural and social systems.

Impact by Sector

Agriculture

Two UN agencies concur that agriculture will be one of the hardest hit sectors in an era of climate change. The ILO is anticipating significant job loss at the production end and reduced labour productivity because of environmental conditions. It will be more challenging to grow crops and raise animals.

Fishing stocks will be lowered as a result of coral bleaching/death and there will be fish stock migration. Vulnerable marine ecosystems, including coral reefs, mangroves and seagrass beds provide the habitat, spawning and nursery grounds for economically important fish species.
Mining and extraction

Fossil fuel production, whilst still important, is at the core of carbon dioxide/greenhouse gas notoriety. Most countries' nationally determined contributions (NDCs) – a commitment to reduce GHGs – indicate significant reduction in fossil fuel use. Quarrying and other clear-felling operations will also increase the risk of flooding, landslides and watershed damage.

Transportation

Energy efficiency with respect to the vehicles used for the transport of passengers and cargo will be a determinant of viability. Road and port infrastructure will be tested by extreme weather events and sea level rise.

Manufacturing

Manufacturing operations will be challenged by the availability of naturally occurring raw materials (from agriculture and mining). Energy efficiency will be a determining factor in the success of the enterprise. Spillover impacts from the transportation sector will affect overall viability.

Financial Services

Issues in the productive, retail, transportation and extractive sectors may restrict economy-wide growth, investment, disposable income and investor confidence. Insurance and reinsurance rates will have to keep abreast of increasing climate related risks.

Tourism/Hospitality

The two most important products, the natural and built environment, and the culinary experience are all threatened by climate change- induced hazards such as hurricanes, floods, drought, fires, sea level rise and pandemics. The pristine condition of beaches can be affected by ridge-based runoff, silt flows and marine phenomena such as algal blooms, e.g. Sargassum.

Retail

Among the leading indirect impacts in this sector are adverse effects on transportation, supply chains, packaging and product life cycles, including reuse and recycling.

Entertainment

The international film and television production industry generates carbon and greenhouse gases from travel, transportation, production material deliveries, onsite generators and even pyrotechnical scenes. To account for the carbon footprint that results from these activities, many productions will hire third party contractors who specialise in carbon and life cycle analysis accounting to track the overall impact from the production.

Health/Wellness

Certain groups within every society have higher susceptibility to climate-induced health impacts owing to their age (children and elderly), gender (particularly pregnant women), social marginalisation (associated in some areas with poverty and racial origin).
Many infectious diseases, including water-borne ones, are highly sensitive to climate conditions.

Climate change lengthens the transmission season and expands the geographical range of many diseases like malaria and dengue.
Climate change will bring new and emerging health issues, including heat stress from heatwaves and impacts from other extreme events. Heat stress can make working conditions unbearable and increase the risk of cardiovascular, respiratory and renal diseases, negatively impacting worker productivity.

Malnutrition and undernutrition are ongoing concerns for a number of developing countries in the face of climate-related food production shortfalls.

CHAPTER 5.
Global Responses

The United Nations Framework Convention on Climate Change (UNFCC) and the Intergovernmental Panel on Climate Change (IPCC)
The ultimate objective of the Convention is “the stabilising of atmospheric concentrations of GHGs at levels that would prevent dangerous human interference with the climate system.” Such levels, which are not specified by the Convention, should be achieved within a sufficient time frame to allow ecosystems to adapt naturally to climate change, to ensure that food security is not threatened, and to enable economic development to proceed in a sustainable manner (UNFCCC, 2002).

In the pursuit of this objective, all parties that have ratified, accepted, approved, or acceded to the treaty are obliged to take steps to respond to climate change. The Convention divides countries into two main groups: those that are listed in its Annex I, known as Annex I Parties, and those that are not, known as non-Annex I Parties. The members of the Organisation for Economic Co-operation and Development (OECD) are also listed in the Annex II of the Convention.
Annex I parties include industrialised countries that have historically contributed the most to global GHG emissions and the resulting climate change.

Table 5 below shows those parties listed in Annex I of the Convention.

Australia	Austria	Belarus
Belgium	Bulgaria	Canada
Croatia	Czech Republic	Denmark
Estonia	European Community	Finland
France	Germany	Greece
Hungary	Iceland	Ireland
Italy	Japan	Latvia
Liechtenstein	Lithuania	Luxembourg
Monaco	Netherlands	New Zealand
Norway	Poland	Portugal
Romania	Russian Federation	Slovakia
Slovenia	Spain	Sweden
Switzerland	Turkey	Ukraine
United Kingdom	United States of America	

Given the historical contribution to emissions by Annex I parties and their greater financial and institutional capacity to address climate change, the Convention mandates that these parties should take the lead in so doing.

Two principles are enshrined in the Convention – equity and "common but differentiated responsibility," requiring that Annex I parties take steps to modify longer-term trends in emissions (UNFCCC, 2002).

Annex I parties were committed to reducing their emissions of greenhouse gases to 1990 levels by the year 2000. This was a non-legally-binding target. All Annex I parties must also submit regular reports, known as National Communications, which give details of climate change policy and measures that have been implemented.

These parties must also submit an annual inventory of GHGs.

Additionally, Annex II parties have an obligation to provide "new and additional financial resources" to developing countries to help them cope with climate change, as well as to facilitate the transfer of climate-friendly technologies to both developing countries and countries with Economies in Transition (UNFCCC, 2002).

All non-Annex I parties, essentially developing countries, do not have emission reduction targets. They are, however, required to report in general terms on actions taken to address climate change and adapt to its effects. Subject to the availability of funds, these parties are also required to submit National Communications, but are not obliged to tender annual GHG inventories.

The Convention is served by a secretariat and two subsidiary bodies: The Subsidiary Body for Scientific and Technological Advice (SBSTA) and the Subsidiary Body for Implementation (SBI). Provisions exist within the framework convention for the adoption of protocols by parties that serve to enhance its objectives.

Global Framework for Climate Services (GFCS)

The Global Environment Facility (GEF), established on the eve of the 1992 Rio Earth Summit, is a catalyst for action on the environment — and much more. Through its strategic investments, the GEF works with partners to tackle the planet's biggest environmental issues.

Global Environment Facility (GEF)

The GEF is a unique partnership of 18 agencies, including United Nations agencies, multilateral development banks, national entities and international NGOs, working with 183 countries to address the world's most challenging environmental issues.

The GEF has a large network of civil society organisations, works closely with the private sector around the world, and receives continuous inputs from an independent evaluation office and a world-class scientific panel. It is a financial mechanism for five major international environmental conventions: the Minamata Convention on Mercury, the Stockholm Convention on Persistent Organic Pollutants (POPs), the United Nations Convention on Biological Diversity (UNCBD), the United Nations Convention to Combat Desertification (UNCCD) and the United Nations Framework Convention on Climate Change (UNFCCC).

GEF is also an innovator and catalyst that supports multi-stakeholder alliances to preserve threatened ecosystems on land and in the oceans, build greener cities, boost food security and promote clean energy for a more prosperous, climate-resilient world, leveraging $5.20 in additional financing for every $1 invested.

The GEF Trust Fund was established to help tackle our planet's most pressing environmental problems. Funds are available to developing countries and countries with economies in transition to meet the objectives of the international environmental conventions and agreements.

Paris Climate Agreement

At the Paris Climate Conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally-binding global climate deal.
The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.
Key elements
The Paris Agreement is a bridge between today's policies and climate-neutrality before the end of the century.
Among the goals for mitigation, especially reducing emissions, the world's governments agreed to:

- A long-term goal of keeping the increase in global average temperature to well below 2°C above pre-industrial levels.
- Aim to limit the increase to 1.5°C, since this would significantly educe risks and the impacts of climate change.
- The need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries.
- Undertake rapid reductions thereafter in accordance with the best available science.

Before and during the Paris conference, countries submitted comprehensive national climate action plans (INDCs). These are not yet enough to keep global warming below 2°C, but the agreement traces the way to achieving this target.

Transparency and Global Stocktake

Governments agreed to:

- Come together every 5 years to set more ambitious targets as required by science.
- Report to each other and the public on how well they are doing to implement their targets.
- Track progress towards the long-term goal through a robust transparency and accountability system.

Adaptation

Governments agreed to:

- Strengthen societies' ability to deal with the impacts of climate change.
- Provide continued and enhanced international support for adaptation to developing countries.

Loss and damage

The agreement also:

- Recognises the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change.
- Acknowledges the need to cooperate and enhance the understanding, action and support in different areas such as early warning systems, emergency preparedness and risk insurance.

Role of cities, regions and local authorities

The agreement recognises the role of non-party stakeholders in addressing climate change, including cities, other subnational authorities, civil society, the private sector and others.
They are invited to:

- Scale up their efforts and support actions to reduce emissions.
- Build resilience and decrease vulnerability to the adverse effects of climate change.
- Uphold and promote regional and international cooperation.

Support

- The EU and other developed countries will continue to support climate action to reduce emissions and build resilience to climate change impacts in developing countries.
- Other countries are encouraged to provide or continue to provide such support voluntarily.
- Developed countries intend to continue their existing collective goal to mobilise US$100 billion per year by 2020 and extend this until 2025. A new and higher goal will be set out after this period.

Ratification

- The agreement opened for signatures for one year on 22 April, 2016.
- To enter into force, at least 55 countries representing at least 55% of global emissions had to deposit their instruments of ratification.
- On 5 October, 2016 the EU formally ratified the Paris Agreement, thus enabling its entry into force on 4 November, 2016

Funding Mechanisms

The Green Climate Fund (GCF) is a global fund created to support the efforts of developing countries to respond to the challenge of climate change. The GCF helps developing countries limit or reduce their greenhouse gas (GHG) emissions and adapt to climate change. It seeks to promote a paradigm shift to low-emission and climate-resilient development, taking into account the needs of nations that are particularly vulnerable to climate change impacts.

It was set up by the 194 countries who are parties to the UNFCCC in 2010, as part of the Convention's financial mechanism. It aims to deliver equal amounts of funding to mitigation and adaptation, while being guided by the Convention's principles and provisions.

When the Paris Agreement was reached in 2015, the Green Climate Fund was given an important role in serving the agreement and supporting the goal of keeping climate change well below 2°C.

Responding to the climate challenge requires collective action from all countries, including by both public and private sectors. Among these concerted efforts, advanced economies have agreed to jointly mobilise significant financial resources. Coming from a variety of sources, these resources address the pressing mitigation and adaptation needs of developing countries.

GCF launched its initial resource mobilisation in 2014, and rapidly gathered pledges worth US$10.3 billion. These funds come mainly from developed countries but also from some developing countries, regions, and one city (Paris).

GCF's activities are aligned with the priorities of developing countries through the principle of country ownership, and the Fund has established a direct access modality so that national and sub-national organisations can receive funding directly, rather than only via international intermediaries.

The Fund pays particular attention to the needs of societies that are highly vulnerable to the effects of climate change, in particular Least Developed Countries (LDCs), Small Island Developing States (SIDS), and African States.

GCF aims to catalyse a flow of climate finance to invest in low-emission and climate-resilient development, driving a paradigm shift in the global response to climate change.

The GCF's innovation is to use public investment to stimulate private finance, unlocking the power of climate-friendly investment for low emission, climate resilient development. To achieve maximum impact, GCF seeks to catalyse funds, multiplying the effect of its initial financing by opening markets to new investments.

The Fund's investments can be in the form of grants, loans, equity or guarantees.

NDCs

The Paris Agreement requests each country to outline and communicate their post-2020 climate actions, known as their Nationally Determined Contributions, or NDCs.

Together, these climate actions determine whether the world achieves the long-term goals of the Paris Agreement and to reach global peaking of greenhouse gas (GHG) emissions as soon as possible and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of GHGs in the second half of this century.

It is understood that the peaking of emissions will take longer for developing countries, and that emission reductions are undertaken on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty, which are critical development priorities for many developing countries.

Each climate plan reflects the country's ambition for reducing emissions, taking into account its domestic circumstances and capabilities. Guidance on NDCs is currently being negotiated under the Ad Hoc Working Group on the Paris Agreement (APA), agenda item 3.
AOSIS and the Politics of Climate Change Negotiations

Small island states have been able to obtain some remarkable achievements in climate change negotiations by building a cohesive coalition, the Alliance of Small Island States (AOSIS). Its cohesion, however, has been affected by changes in the UNFCCC process.

The increase both in the number of issues on the climate agenda and the number of negotiation groups may have helped or hindered compromise and finding common ground. To track how AOSIS has fared in the climate change regime, the activities and positions of AOSIS, and of individual AOSIS members over three distinct periods (1995–2000, 2001–2005, 2006–2011, 2012-2018) in the climate change regime, are compared.

It is found that group activity has declined in relative terms and although there is overall agreement regarding mitigation and adaptation, there is less consensus regarding forestry (e.g. land use, land-use change, and forestry (LULUCF) and reducing emissions from deforestation and degradation (REDD)) issues. However, despite controversies in some areas, AOSIS has remained a tightly coordinated and cohesive alliance that continues to be a key player in global climate policy.

CHAPTER 6.

Regional Responses: **Key Agencies & Services**

SIDS DOCK

SIDS DOCK is an initiative among AOSIS member countries to provide Small Island Developing States (SIDS) with a collective institutional mechanism to assist with transform national energy sectors into a catalyst for sustainable economic development and help generate financial resources to address adaptation to climate change

CARICOM Climate Change Centre

The Caribbean Community Climate Change Centre (CCCCC) coordinates the region's response to climate change, working on effective solutions and projects to combat the environmental impacts of climate change and global warming.

CIMH- Regional Climate Centre (RCC)

The WMO Caribbean RCC builds upon the rich history of the Applied Meteorology and Climatology Section (AMCS) at the Caribbean Institute for Meteorology and Hydrology (CIMH) to develop and deliver critical climate services and products to the region. Within the Caribbean, the AMCS has created a strong research and development programme in the area of climate variability which, although it has a significant impact on the sustainable development of many islands of the Caribbean, is under-appreciated relative to long-term climate change.

Climate Studies Group, Mona (CSGM) Climate Research

In 1994 the Climate Studies Group (CSGM) was formed within the Physics Department of the Mona, Jamaica campus of the University of the West Indies. Physicists engaging in climate studies is not unusual since physics is the main discipline used to understand climate processes, the equations of motion, thermodynamics, hydrodynamics, radiation and cloud physics, as well as equations for atmospheric water. Climate, rather than weather, is the subject of investigation.

a. Regional Coordination
b. Policy Interventions

Frequently Asked Questions (FAQs)

The following are among some of the frequently asked questions on the issue of climate change. Answers proposed to these questions reflect general consensus among climate change scientists.

Q 1. Is our climate really changing?

A Yes. In the last century, our planet's average temperature has risen by over half a degree Celsius. Earlier springs, melting ice, and rising sea levels give a collective picture of a changing climate. Most scientists now agree that the earth's climate is changing, and it is not just because of better measurements or data collection. The changes have been seen for long enough to satisfy temporal timescales over which climate is observed.

Q 2. Does the climate vary naturally?

A Yes. The earth's climate swings naturally, in a slow process. Current human activities are resulting in accelerated changes.

Q 3. Can we stop climate change from occurring?

A We can't easily change the climate or stop it from changing in the future. It's too late to stop the climate change that's now occurring as a result of increased carbon dioxide emissions in the 20th century. But if we change our fuel-thirsty lifestyles now, we may be able to slow down the effects and learn to adapt better to change in the future.

Q 4. If climate changes, impacts will be felt some time in the future. Why should I care?

A The climate affects the lives of all people, and will continue to do so in the future. We have a moral responsibility to pass on to future generations (by the principle of intergenerational equity) an environment that is no more degraded than we received it. Besides, actions we now take could reduce our vulnerability to current extreme events and natural hazards.

Q 5. What are greenhouse gases?

A Carbon dioxide, methane, nitrous oxides, ozone, water vapour, chlorofluorocarbons (CFC), perfluorocarbons, and sulphur hexafluoride are all greenhouse gases (GHGs) found in our atmosphere. They trap heat and redirect it towards the earth's surface (the greenhouse effect). The concentration of GHGs is rising rapidly by burning fossil fuels to sustain our modern lifestyle. This is increasing atmospheric warming, leading to higher surface temperatures (global warming).

Q 6. What is the Kyoto Protocol?

A The Kyoto Protocol was adopted in 1997. For industrialised countries – those countries which have been mostly responsible for increases in greenhouse gases since the mid-1800s (Industrial Revolution) – the Protocol establishes legally-binding targets to reduce emissions. These targets relate to six greenhouse gases over a five-year period from 2008 to 2012 (known as the first commitment period). The Protocol requires developed countries and countries with economies in transition to reduce their GHG emissions to about 5 per cent below 1990 levels.

Q 7. Which nations are the worst polluters?

A The chief emitter of greenhouse gases is the United States. It has 5 per cent of the world's population, but accounts for 24 per cent of global carbon dioxide emissions. Other industrialised nations are also major emitters. China and India are major emitters from developing countries.

Q 8. Why is the United States of America not participating in the Kyoto Protocol? Why has it withdrawn from the Paris Agreement?

A The U.S. government feels that the country's economy will be unfairly hit by Kyoto commitments. It maintains that Kyoto is flawed in that it excludes some greenhouse gases such as ozone and does not impose emission reduction targets on large developing countries (such as India and China). However, it has recently announced its participation in the Asia- Pacific Partnership on Clean Development and Climate.

Q 9. How much do developing countries contribute to global emissions?

A The developing world has until now been responsible for only 25 per cent of global emissions. But a few highly populated countries in the developing world, including India and China, are now in the top 10 of global emitters.

Q 10. Has climate change caused more frequent and intense extreme weather events?

A Based on current evidence, it would be fair to say that there has been an increase in extreme weather events coincident with the changing climate. All other things being equal, a warmer world (with warmer oceans) could favour the development of more frequent or intense systems.

Q 11. Can climate-induced changes be caused by occurrences other than those to which we now attribute climate change?

A Yes. Unsustainable practices such as pollution and deforestation can negatively affect ecosystems and, in turn, climate.

Q 12. The Caribbean has made a negligible contribution of 1 per cent of greenhouse gases, so what can we do?

A We are very vulnerable to current climate and weather extremes and even more so to the potential impacts of climate change and sea level rise. We can also commit to a less carbon-intensive path for future development through the use of renewable energy and implementing energy-efficient measures. We must also promote the use of best practices and educate ourselves about threats and remedial actions that can be taken.

Q 13. Are El Niños related to global warming?

A El Niño refers to the above-normal warming that occurs on a 3 to 7-year cycle along the western coast of South America (Peru and Ecuador). The phenomenon is so named because the warming occurs around Christmas time and El Niño is the Spanish term for the Christ child. El Niño's are not caused by global warming.

Clear evidence exists from a variety of sources (including archaeological studies) that El Niño's have been present for hundreds – and some indicators suggest maybe millions – of years. However, it has been hypothesised that warmer global sea surface temperatures can enhance the El Niño phenomenon, and it is also true that El Niño's have been more frequent and intense in recent decades.

Recent climate model simulations suggest that in the 21st century, with increased greenhouse gas concentrations in the atmosphere, El Niño-like sea surface temperature patterns in the tropical Pacific are likely to be more persistent.

Q 14. Is sea level rising?

A Global mean sea levels have been rising at an average rate of 1 to 2 millimetres per year over the past 100 years, which is significantly greater than the rate averaged over the last several thousand years. Projected increase from 1990-2100 is anywhere from 0.09m to 0.88m, depending on which greenhouse gas scenario is used, as well as the many physical uncertainties in contributions to sea level rise from a variety of frozen and unfrozen water sources.

Q 15. Is ozone depletion a cause of global warming?

A No. Ozone depletion occurs in the upper levels of the atmosphere, where certain gases break down the ozone layer that protects the earth from the harmful ultraviolet radiation from the sun. Global warming occurs as a result of heat trapped by greenhouse gases in the lower atmosphere. Of note, however, is the fact that at least one family of greenhouse gases (CFCs) is also an ozone-depleting gas.

Q 16. What is the Intergovernmental Panel on Climate Change?

A The IPCC was formed jointly in 1988 by the United Nations Environment Program and World Meteorological Organisation. The IPCC brings together the world's top scientists in all relevant fields, synthesises peer-reviewed scientific literature on global warming studies, and produces authoritative assessments of the current state of knowledge of climate change.

NOTES