Climate Change in the Caribbean and the Challenge of Adaptation

United Nations Environment Programme
Regional Office for Latin America and the Caribbean

In collaboration with

CARICOM

ISBN: 978-92-807-2963-4
job number :DEW/1088/PA

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This publication should be referenced as:

UNEP (United Nation Environment Programme), 2008. *Climate Change in the Caribbean and the Challenge of Adaptation*. UNEP Regional Office for Latin America and the Caribbean, Panama City, Panama.
Printed in Panama City, in October 2008

Cover design: Francisco Cedeño. Photographs: Alejandro Balaguer, Albatros Media Foundation. www.albatrosmedia.net
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ACKNOWLEDGEMENTS

UNEP acknowledges the contributions made by many governments, individuals and institutions to the preparation and publication of this report. Special thanks are extended to the Caribbean Community Climate Change Centre, the University of the West Indies, the Water Center for the Humid Tropics of Latin America and the Caribbean, and the following individual experts for their interest and contribution towards the preparation of the publication:

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Foreword

The magnitude of the threat posed by climate change requires all United Nations bodies, as part of the international community, to respond to the challenge in a coordinated manner and to deliver concrete results. As the principal UN body in the field of the environment, the United Nations Environment Programme provides leadership and encourages partnership in caring for the environment and, by inspiring and informing nations, UNEP enables citizens to improve their quality of life without compromising that of future generations.

In the Caribbean region climate change involves a symbiosis of threats, risks, challenges and opportunities. The Region faces impacts of climate change, a problem to whose making it has had little to contribute. With this report, "Climate Change in the Caribbean and the Challenge of Adaptation", we hope to contribute to the dialogue between policy-makers and the scientific community to build a stronger agenda that will maximize opportunities and address, in the most appropriate manner, threats and risks resulting from potential climate change.

To that end, the report highlights climate change trends and climate variability, the impact they have on Caribbean Small Island Developing States (SIDS) in particular, and the efforts in responding to these issues. Its portrayal of regional actions is intended to offer a broad appreciation of the efforts at national and regional levels, highlighting successful experiences and good practices, as well as identifying gaps in knowledge and institutional weaknesses for addressing the threats, risks, challenges and opportunities associated with climate change.

Despite the region's limitations, it has taken and continues to take action to improve its capacity to act in a concerted manner in pursuing common objectives in addressing the challenges associated with climate change. Caribbean countries have been prompted to include environmental considerations in their development policies because of the potential threats posed by climate change to the natural resource base that sustains their economic growth. Although poverty eradication, education, health and housing continue to be priority problems, climate change is becoming increasingly of greater importance, on the national agendas of Caribbean countries.

The evidence in this report suggests that there is an urgent need for the Region to take the necessary action to respond to the challenges climate change poses to their sustainable development. In this regard, this report provides guidance on how the Region should respond, not only in developing national climate change agendas, but also in building an international regime on adaptation to climate change as well as on the implementation of the Kyoto Protocol and beyond, taking into account the particular needs of the Caribbean SIDS.

Acronyms

- **ACS** Association of the Caribbean States
- **AOSIS** Alliance of Small Island States
- **BPoA** Barbados Programme of Action for the Sustainable Development of Small Island Developing States
- **CATHALAC** Water Center for the Humid Tropics of Latin America and the Caribbean
- **CARICOM** Caribbean Community and Common Market
- **CDERA** Caribbean Disaster Emergency Response Agency
- **CEP** Caribbean Environment Programme of UNEP
- **CHAMP** Caribbean Hazard Mitigation Capacity Building Programme
- **CIDA** Canadian International Development Agency
- **CPACC** Caribbean Planning for Adaptation to Climate Change
- **CSI** Coastal Regions and Small Islands platform of UNESCO
- **ECLAC** Economic Commission for Latin America and the Caribbean
- **ENSO** El Niño-Southern Oscillation
- **GCOS** Global Climate Observing System
- **GEF** Global Environment Facility
- **GHG** Greenhouse Gas
- **GIN** Global Islands Network
- **ICSU** International Council for Science
- **IOC** Intergovernmental Oceanographic Commission of UNESCO
- **IPCC** Intergovernmental Panel on Climate Change
- **LDCF** Least Developed Countries Fund
- **MACC** Mainstreaming Adaptation to Climate Change
- **MEA** Multilateral Environmental Agreement

- **NAPA** National Adaptation Programme of Action
- **OAS** Organization of American States
- **ODA** Official Development Assistance
- **OECS** Organization of Eastern Caribbean States
- **SBSTA** Subsidiary Body for Scientific and Technological Advice
- **SCCF** Special Climate Change Fund
- **SIDS** Small Island Developing States
- **SRES** Special Report on Emissions Scenarios (from the IPCC)
- **UNEP** United Nations Environment Programme
- **UNDESA** United Nations Department of Economic and Social Affairs
- **UNDP** United Nations Development Programme
- **UNESCO** United Nations Educational, Scientific and Cultural Organization
- **UNFCCC** United Nations Framework Convention on Climate Change
- **USAID** United States Agency for International Development
- **WMO** World Meteorological Organization

Introduction

The year of 2007 was of particular importance for the science of climate change, with the work done by IPCC[1] producing irrefutable evidence of climate change due to human activities, and putting an end to arguments on the scientific credibility surrounding global warming. The fourth IPCC Report reveals consistent trends of how the world's climate is evolving[2] towards increased warming with profound consequences for the global climate and, therefore, for human beings.

The IPCC 2007 Report indicates that, since 1750, global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have markedly increased as a result of human activities and now far exceed pre-industrial values determined from ice cores spanning many thousands of years. Global increases in carbon dioxide concentrations are due primarily to fossil fuel use and land use change, while increases in methane and nitrous oxide are primarily related to agriculture (IPCC 2007a).

Concentration of carbon dioxide, the most important anthropogenic greenhouse gas (GHG), increased from a pre-industrial value of about 280 parts per million (ppm) to 379 ppm in 2005, with an average annual increase between 1995 and 2005 of 1.9 ppm per year (IPCC 2007a). Annual carbon dioxide emissions increased from an average of 6.4 gigatons of carbon (GtC)[3] per year in the 1990s to 7.2 GtC per year between 2000 and 2005.

The global atmospheric concentration of methane – the second most significant GHG - has increased from a pre-industrial value of about 715 parts per billion (ppb) to 1732 ppb in the early 1990s, and was 1774 ppb in 2005. Global atmospheric nitrous oxide concentration also increased from a pre-industrial value of about 270 ppb to 319 ppb in 2005, although the growth rate has been almost constant since 1980 (IPCC 2007a).

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1 The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) in 1988. It is open to all member states of the UN and WMO. The role of the IPCC is to assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options of adaptation and mitigation.

2 The IPCC 4th Assessment Report (AR4) consists of four volumes released in the course of 2007. Compared to the 2001 report, the AR4 pays greater attention to the integration of climate change with sustainable development and the inter-relationships between mitigation and adaptation. Specific attention is given to regional issues, uncertainty & risk, technology, climate change & water. The Report consist of four sections namely: "The Physical Science Basis", "Impacts, Adaptation and Vulnerability", "Mitigation of Climate Change", and a summary report. http://www.ipcc.ch/press/factsheet.htm.

3 An emission of 1 GtC (gigaton of carbon) corresponds to 3.67 $GtCO_2$ (gigatons of carbon dioxide).

Based on these data, IPCC has concluded, with *very great confidence,* that the global average net effect of human activities since 1750 has been of unequivocal warming, with a radiative forcing[4] of +1.6 W m–2 (IPCC 2007a).

As confirmation of the conclusion, eleven of the twelve years (1995 – 2006) rank among the warmest years in the instrumental record of global surface temperature[5] (since 1850). The total temperature increase between 1850–1899 and 2001–2005 reached 0.76°C. The temperature of the world's oceans has also been rising, and mountain glaciers and snow cover have declined in both hemispheres. All these phenomena contribute to an average global sea level of 1.8 mm per year from 1961 to 2003, and at a faster rate – about 3.1 mm- from 1993 to 2003.

For the next two decades, warming of about 0.2°C per decade is projected for a range of SRES[6] emission scenarios. Continued GHG emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century.

This report is intended to reflect the main expected impacts of global climate change in the SIDS, and to share information on how Caribbean countries are responding to the challenge.

It covers the 16 Caribbean SIDS included in the United Nations official list of SIDS, sharing important challenges and having strong historical, cultural and political links.

They are also member states of the Caribbean Community and Common Market (CARICOM). Also included in this assessment are other dependant territories of the Caribbean Sea that share similar environmental and socioeconomic conditions.

4 Radiative force refers to a measure of the influence that a factor has in altering the balance of incoming and outgoing energy in the Earth-atmosphere system and is an index of the importance of the factor as a potential climate change mechanism. Positive forcing tends to warm the surface while negative forcing tends to cool it, and is expressed in watts per square metres.

5 The average of near-surface air temperature over land and sea.

6 SRES refers to the IPCC Special Report on Emission Scenarios (2000).

The report is divided into four chapters, which deal sequentially with:

- *The impact of climate change and the Caribbean Region* contains a general overview of Climate Change in the SIDS and particularly in the Caribbean, considering the general characteristic of the region.
- *SIDS, the Caribbean Region and the International Political Framework for Climate Change* summarizes a road map of how the climate change and SIDS debate evolved - internationally and in the region - following the consideration of those issues in: the Barbados Programme of Action; the United Nations Millennium Summit (2000) and the Millennium Development Goals (MDG); the World Summit on Sustainable Development; the Mauritius Strategy for the further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States; the United Nation Framework Convention on Climate Change (UNFCCC); and the Kyoto Protocol.

- *Responding to vulnerability and adaptation needs in the Caribbean Region* addresses vulnerability and adaptation in the general context of SIDS, and in the Caribbean in particular, including the availability of methodologies and tools for vulnerability and adaptation assessment and the consideration of regional scenarios, relevant institutions and projects. It also examines how the Caribbean region is responding by adapting to the vulnerability and climate change challenges. Key projects (CPACC, ACCC, and MACC) and institutions (CCCCC) are identified. This chapter also includes references to insurance as a tool for risk reduction and risk management, and to the international and regional frameworks for cooperation and capacity building. Emphasis is on the role of CARICOM, the OECS, the Forum of Ministers of Environment of Latin America and the Caribbean, among others.

- *A time for concrete action* identifies some types of action that briefly reflect on key issues to be addressed in the Caribbean region when facing climate change.

Chapter I

The Impact of Climate Change and the Caribbean Region

1.1 Climate Change in the general context of SIDS

Small islands, whether in the tropics or at higher latitudes, have characteristics that make them especially vulnerable to the effects of climate change, such as sea level rise and extreme meteorological events.

Currently, fifty-one Small Island Developing States (SIDS) are included in the list used by the United Nations Department of Economic and Social Affairs (UNDESA) in monitoring the sustainable development of SIDS. These countries are often categorized by their three regions; the Caribbean, the Pacific, and the AIMS (Africa, Indian Ocean, Mediterranean and South China Sea). These States and territories often work together in the United Nations through the Alliance of Small Island States (AOSIS)[7].

SIDS worldwide share a number of environmental and socio-economic characteristics which impose upon them varying levels of environmental, economic and social vulnerability, and present particular sustainable development challenges (Box 1).

Box 1: Major environmental and socio-economic challenges in SIDS

- Productive sectors heavily dependent on their limited natural resource base (e.g., agriculture, forestry, fishing, tourism).
- Susceptibility to the vagaries of international trade.
- High transportation and communication costs.
- Serious vulnerability to extreme climate events and other natural disasters.
- Scarce land resources.
- Increasing pressures on coastal and marine environments and resources.
- Small domestic markets.
- Limited ability to develop economies of scale.
- High import content (especially of strategic imports such as food and fuel).
- Limited economic diversification possibilities.
- Limited extent to which domestic competition policy can be applied.
- Dependence on a narrow range of export products.
- Inability to influence international prices.
- Uncertainties of supply due to remoteness or insularity.
- Shifting rainfall patterns and cyclones, typhoons and hurricanes.

Source: UNEP 2005, UNFCC 2007b

7 The Alliance of Small Island States (AOSIS) is a coalition of Small Island and low-lying coastal countries that share similar development challenges and concerns about the environment, especially their vulnerability to the adverse effects of global climate change. It functions primarily as an ad hoc lobby and negotiating voice for SIDS within the United Nations system. AOSIS has a membership of 43 States and observers, drawn from all regions of the world: Africa, Caribbean, Indian Ocean, Mediterranean, Pacific and South China Sea. Thirty-seven are members of the United Nations, close to 28 per cent of developing countries, and 20 per cent of the total membership of the United Nations. Together, SIDS communities constitute some 5 per cent of the global population. www.un.org/esa/sustdev/sids/sids.htm.

Environmental vulnerability is related to the risk of damage to a country's natural capital. The series of environmental vulnerabilities faced by SIDS includes: natural hazards (e.g. hurricanes, earthquakes, tsunamis and volcanic eruptions); internal anthropogenic hazards (e.g. deforestation), which over time reduce intrinsic ecosystem resilience; externally driven, anthropogenic hazards (e.g. transport of toxic waste); and global climate change, the effects of which are particularly severe on SIDS (UNEP 2005).

Although SIDS contribute with less than one percent of global GHGs emissions (UNFCCC 2007a), they already experience adverse effects of climate change including: sea level rise; tropical cyclones/hurricanes; droughts; increasing sea surface temperatures; and coral bleaching; and other adverse phenomena (Box 2).

Box 2: Some expected impacts on SIDS as a result of vulnerability to the effects of climate change, sea level rise and extreme events

- Deteriorating coastal conditions, e.g. through beach erosion and coral bleaching, are expected to adversely affect local resources, fisheries for example, and reduce their value as tourist destinations.
- Floods, storm surge, erosion and other coastal hazards, exacerbated by sea-level rise and that threaten vital infrastructure, settlements and facilities that support the livelihood of island communities.
- Reduction in freshwater resources by mid-century, to the point where they cannot meet demand during low rainfall periods.
- Increased invasion by non-native species as a result of higher temperatures is also expected, particularly on middle and high-latitude islands.
- Economics losses from reduced agricultural yields. For example, shortening of the growing season, drought.
- Loss of mangrove forests and coral reefs due to sea level raise.
- Bleaching and acidification of the ocean.
- Damage to terrestrial forest caused by extreme events.
- Reduction in the size of freshwater lenses and of general water resource availability due to decreased rainfall and saltwater intrusion.
- Inundation of coastal settlements and arable land on the coast.
- Reduction in tourism due to increased frequency and severity of extreme weather.

Source: IPCC 2007b, UNFCCC 2007a

1.2 The Caribbean Region

The Wider Caribbean Region comprises all the 28 insular and coastal states and 10 territories bordering the Caribbean Sea and the Gulf of Mexico. The combined area of the Caribbean Sea and the Gulf of Mexico is approximately 5 326 000 km^2.

The report covers the 16 Caribbean SIDS included in the United Nations official list of SIDS, sharing important challenges and having strong historical, cultural and political links (Table 1).

Table 1: States and dependent territories of the Caribbean covered in this report and their UN SIDS and CARICOM affiliation

Independent countries Antigua and Barbuda (SIDS, CARICOM) Bahamas (SIDS, CARICOM) Barbados (SIDS, CARICOM) Belize (SIDS, CARICOM) Cuba (SIDS) Dominica (SIDS, CARICOM) Dominican Republic (SIDS) Grenada (SIDS, CARICOM) Guyana (SIDS, CARICOM) Haiti (SIDS, CARICOM) Jamaica (SIDS, CARICOM) St Kitts and Nevis (SIDS, CARICOM) St Lucia (SIDS, CARICOM) St Vincent and the Grenadines (SIDS,CARICOM) Suriname (SIDS, CARICOM) Trinidad and Tobago (SIDS, CARICOM)	**Netherlands Constituent Countries** Aruba (SIDS) Netherlands Antilles (SIDS) **French Overseas Departments** Guadeloupe Martinique **Territories of the United States of America (USA)** Puerto Rico (SIDS) US Virgin Islands (SIDS) **British Overseas Territories** Anguilla (US SIDS) British Virgin Islands (SIDS) Cayman Islands Montserrat (SIDS, CARICOM) Turks and Caicos Islands

Note: Not all the dependent territories share the same status as their respective metropolis. For example, Puerto Rico and the US Virgin Islands have different status to the relationship between The Netherlands and its Constituent Countries of Aruba and the Netherlands Antilles.

Source: UNEP 2005

1.2.1 General Characteristics

Caribbean countries are in the tropics, generally between latitudes 11 and 18 degrees north, from Suriname in the south to The Bahamas in the north. (Figure 1a). The region generally consists of island states, the exceptions being Belize in Central America, and Guyana and Suriname, situated on the South American continent. The topography is generally rugged and mountainous with small areas of flat land in coastal areas. Several islands are volcanic in origin, while others are comprised primarily of coral.

The small islands and low-lying states of the Caribbean, like other SIDS, share a number of socio-economic challenges (See Box 1). Among which are: a heavy dependence upon the natural resource base (agriculture, forestry, fishing, tourism, mining and light manufacturing); susceptibility to the vagaries of international trade; lack of economies of scale; high transportation and communication costs; extreme vulnerability to natural disasters; scarce land resources; and ever increasing pressures on coastal and marine environments. These are compounded by limited availability of human capacity and the means to manage and use natural resources on a sustainable basis.

Figure 1a: The Caribbean Region

Source: UNEP ROLAC Atlas of the World, Comprehensive Edition, The Times 1994

Population

Inhabited by an estimated 39 million people,[8] the Caribbean region is renowned for its physical beauty and its unique culture. For centuries people in the Caribbean have derived their livelihoods primarily from its natural resources, ranging from metals and minerals to endemic flora, fauna and marine life.

Approximately 70 per cent of the Caribbean population lives in coastal cities, towns and villages, a consequence of: the abundance of relatively easy to navigate and, therefore, very accessible natural harbours; the export oriented economy; the importance of artesian fisheries; and the tourism industry's coastal focus. More than half the population lives within 1.5 km of the coast and international airports, roads and capital cities are commonly situated along the coast (Mimura and others 2007).

Biodiversity

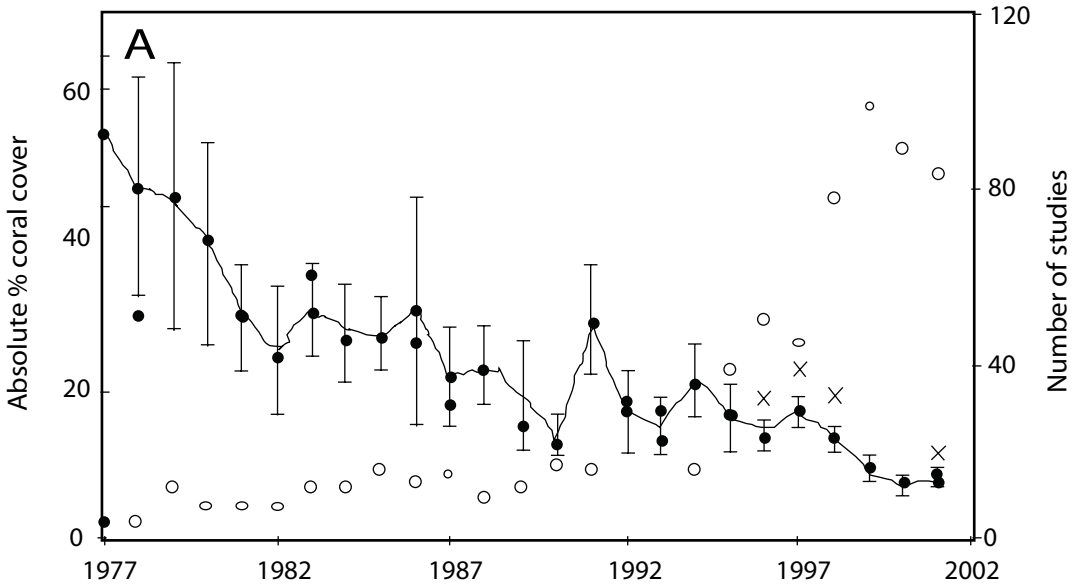
The Caribbean region is also characterized by fragile terrestrial, marine and coastal ecosystems and a high biological diversity. The high level of endemism is attributed to its insularity with an isolated evolutionary pattern that allows speciation. Of vertebrates, excluding fishes, 54 percent are thought to be endemic, as are 59 percent of plants (UNEP 2005). The region is also home to a number of rare and globally significant endangered species.

The small size and significant endemic biological diversity of the islands' ecosystems make for a very fragile environment. The ecological fragility is exacerbated by the constraints of a limited land resource base and the interdependence of the economy and the environment. For example, coral reefs are considered to be among the most fragile; however, they are the most important for tourism and for fisheries, and they also protect against coastal erosion. Equally disturbing is the rapid conversion of agricultural lands to uses that are essentially irreversible.

Recent studies suggest that some 80% of living coral in the reefs of the Caribbean has been lost in the past 20 years (Figure 1b). Absolute percent coral cover of the reefs investigated is the average difference between the estimated percent live coral at the start and end of each year of the study period. This unprecedented rate of degradation has seen some reefs change from 50% cover with live coral organisms, to just 10%. It has been estimated that the continued decline of coral reefs could cost the region between US$350m and US$870m per year by 2050 (CARSEA).

8 Estimation based on the information on www.un.org/esa/sustdev/sids/sids.htm.

Figure 1b: Absolute Percent Coral Cover From 1977 to 2001 Across the Caribbean Basin



Source: Gardner et al, 2003

Disrupted Ecosystems: Great Barrier Reef, Belize, 2006

Source: The Canary Project. http://www.canary-project.org/photos_belize6.html [9]

9 The photographs in this series were shot in the Great Barrier Reef in Belize, a UNESCO World Heritage site. Coral reefs here and around the world are dying due to rising ocean temperatures and other environmental stresses. According to the National Oceanic & Atmospheric Administration (NOAA), "mass coral bleaching events have increased in frequency and intensity since the first recorded event in 1982, resulting in significant coral mortality and other ecological, social and economic impacts in many reef ecosystems.These increases in coral bleaching over the past two decades have been attributed to ocean warming seen in tropical waters around the world. In 2005, Caribbean coral reefs experienced massive coral bleaching followed by coral disease outbreaks and high levels of coral mortality throughout the region. This was the most widespread and severe bleaching ever reported in the Caribbean Sea."

Water resources

Available freshwater in the Caribbean SIDS is considerably less than in oceanic islands. In 2002 freshwater resources (that is, internal renewable water resources) in the Caribbean (not including LLCS) were 2 532 m^3 per capita, compared to 17 607 m^3 in the Western Indian Ocean and 127 066 m^3 in the South Pacific. At current population levels, the available water supply in some of the Caribbean SIDS is significantly lower than the international limit of 1,000 m^3 per capita per year below which a country is classified as 'water scarce'. This limit places Antigua and Barbuda (800 m^3 per capita), Barbados (301 m^3 per capita), and St. Kitts and Nevis (621 m^3 per capita) in the category of water-scarce countries (UNEP 2005).

Many Caribbean islands rely almost entirely on a single source of water such as groundwater, imports, rainwater, surface reservoirs, rivers and other surface flows. The situation is critical in the low limestone islands of the Eastern Caribbean, where seasonal rainfall is very pronounced. In islands such as Anguilla, Antigua and Barbuda, Grenada, and Barbados, more than 65 per cent of total annual rainfall may be recorded in the wet season from June to December (UNEP 2005).

Recent modelling of current and future water resources on several small islands in the Caribbean, using a macro-scale hydrological model and the SRES scenarios, found that any of these islands would be exposed to severe water stress under all SRES scenarios (UNFCCC 2007a).

Coastal areas

Concentration of socio-economic activities within the coastal areas means that activities on land are likely to have an impact on coastal and marine ecosystems. Land degradation associated with human induced behaviour such as unsustainable farming techniques, habitat destruction, deforestation, and exacerbated soil erosion, results in sedimentation of reefs, seagrass beds and coastal wetlands. This is particularly evident during periods of heavy rainfall when large quantities of terrestrial matter are carried to the marine environment via the rivers, streams and gullies.

Although almost 70 per cent of the Caribbean Region population lives in coastal cities, towns and villages, there is only limited investment in waste management systems. Coastal areas are being contaminated with solid waste, sewage, industrial effluents, chemical run-off from agriculture, and wastes from the transportation sector (lubricants, coolants, battery acid, tires). It has recently been estimated that 70% of Caribbean beaches are eroding at rates of between 0.25 and nine metres per year (CARSEA)

Forest

Forest area in the Caribbean[10] increased by 11 percent between 1990 and 2005 (FAO 2007), mostly thanks to reforestation efforts in Cuba. (Table 2). A few countries in the region remain highly forested and, in a number of cases, removals of CO_2 substantially exceed emissions. Most notable are the large tracts of forest in Belize – where over 70% of the country remains under natural vegetation cover (2002 data) - and Guyana where approximately 76% percent of land area is covered with forest (2002 data). Likewise, more than 80% of Suriname´s land is covered by forest. However, deforestation and land degradation are serious issues in Haiti where they are driven by poverty and poor socio-economic conditions.

Table 2: Extent and change of forest area in the Caribbean

AREA (1000 ha)			ANNUAL CHANGE (1000 ha)		ANNUAL CHANGE RATE(%)	
1 990	2 000	2 005	1990-2000	2000-2005	1990-2000	2000-2005
6 350	6 706	6 706	36	54	0.65	0.92

Source: FAO 2007

1.2.2 Climate

The Caribbean region climate is characterized by dry winters and wet summers with the dominant influence of the North Atlantic subtropical high (NAH). During winter, the NAH lies further south with strong easterly trade winds modulating the region's climate and weather which is then usually at its driest with reduced atmospheric humidity (UNFCCC 2007a).

Together with a strong inversion, a cool ocean, and reduced atmospheric humidity, the region is generally at its driest during the Northern Hemisphere winter. With the onset of the Northern Hemisphere spring, the NAH moves northwards, trade wind intensity decreases, and the region then comes under the influence of the equatorial trough (Mimura and others 2007).

An analysis of data from the late 1950s to 2000 has shown that the number of very warm days and nights in the Caribbean is increasing dramatically and very cool days and nights are decreasing, while the extreme inter-annual temperature range is also decreasing. The Caribbean Sea has warmed by 1.5ºC over the last century. The maximum number of consecutive dry days is decreasing and the number of heavy rainfall events is increasing. However, there is a trend towards an overall decrease in precipitation, with prolonged dry spells having occurred over the past few decades (UNFCCC 2007a). (Table 3).

10 The FAO breakdown for the Report includes in the Caribbean Region: Antigua and Barbuda, Bahamas, Barbados, Bermuda, British Virgin Islands, Cayman Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, United States Virgin Islands.

Table 3: Atlantic Ocean and Caribbean climate scenarios for the 2050s and 2080s, as inferred from the atmosphere-ocean circulation models (AOGCMs)

Annual Mean Temperature Change (°C)			
2050s		2080s	
GHG	GHG+A	GHG	GHG+ A
2.03 (+/- O.43)	1.71 (+/- 0.25)	3.06 (+/-0.84)	2.64 (+/- 0.61)
Annual Mean Precipitation Change (%)			
2050s		2080s	
GHG	GHG+A	GHG	GHG+ A
-5.2 (+/-11.9)	-1.3 (+/- 7.8)	-6.8 (+/-15.8)	-O.7 (+/- 12.3)

Note: Numbers in brackets show standard deviation between model projections. + A in the projected change with the aerosol effect added.

Source: UNFCCC 2007a

Most Caribbean islands are too small to be identified with a grid point in global climate models, limiting the ability to generate future projections for climate change. Nevertheless most regional projections are reasonably sound and suggest that permanent climate shocks to the Caribbean countries are expected to include: sea level rise; higher surface air and sea temperatures; extreme weather events, such as tropical storms and hurricanes; and "*El Nino*-like" conditions are also expected to become either more frequent or more severe, or both; rain intensity is also expected to increase, leading to both more frequent as well as more severe flooding (World Bank 2003).

1.2.3 Economic Activities

Economic activities in the Caribbean primarily involve direct exploitation of natural resources such as coastal and marine ecosystems, forests, agricultural land, and mineral resources.

Tourism is the major and most rapidly growing industry across the region. Mining and mineral extraction industries, located principally in the larger islands, are also important engines of economic growth and development. The major foreign exchange earning sectors and employers are mining, tourism, agriculture and offshore banking, all of which are very likely to be disrupted by extreme meteorological events of which hurricanes are the most common. Mining is an important sector in some Caribbean countries, especially in

Guyana, Jamaica, and Trinidad and Tobago accounting for, respectively, 19.3 per cent, 7.9 per cent and 10.6 per cent of GDP (UNEP 2005). In Jamaica the bauxite-alumina industry is one of the most important economic earners. (Goverment of Jamaica 2000). Gold, diamond, and bauxite mining is important in Guyana (gold, diamond, bauxite) (Goverment of Guyana 2002). Dominican Republic is also an exporter of ferro nickel and gold. In many countries of the region sand mining is reported as being a problem for coastal zone conservation (UNESCO 1998).

In the Caribbean fish provide a vital resource for poor communities in ways which do not always appear on the national accounts. It is estimated, for example, that fish products account for seven per cent of the protein consumed by people in the Caribbean region. Fishing is also a significant provider of jobs and income in the Caribbean. It is estimated that more than 200,000 people in the region are directly employed, either full-time or part-time, as fishers. In addition, some 100,000 work in processing and marketing of fish, with additional job opportunities in net-making, boat building and other supporting industries (CARSEA).

Offshore banking is a fast growing sector in the Caribbean (UNEP 2005). In The Bahamas the banking and finance sector accounts for approximately 15% of GDP. These banks are generally non-resident or offshore companies that generate no Bahamian dollar earnings, and cover their expenses by bringing in foreign exchange (Commonwealth of The Bahamas 2001). In Barbados the late 1980s and 1990s saw a shift towards offshore banking services (Goverment of Barbados 2001). Belize also reports a continuous growth in finance and insurance, including offshore banking sub-sectors (Goverment of Belize 2002).

Tourism

The close relationship between tourism, the region's major economic sector, and the natural resource base demands a good natural capital sustainable management capacity, and it is the prime necessity for the continued long-term economic viability of these small island states. Relative to its size, the island population of the Caribbean is more dependent on income from tourism than that of any other part of the world. In 2004, more than 2.4 million people were employed either directly or indirectly in travel and tourism, accounting for 15.5% of total employment, a proportion nearly twice as high as the global average.

The sector contributed US$28.4bn to the Gross Domestic Product, 13% of the total, and US$19bn or 16% of exported services and merchandise. Over one fifth (21.7%) of all capital investment was linked to tourism, well over twice the global average (CARSEA).

In The Bahamas, for example, the 70 per cent employment rate in the tourism industry depends on healthy beaches and reefs, and the integrity of the coastal infrastructure (Trotz 2004).

Sea-level rise and accelerated beach erosion, degradation of coral reefs (including bleaching), and the loss of cultural heritage along the coasts due to flooding make the SIDS less attractive to tourists. Any increases in the frequency or intensity of hurricanes and cyclones also strongly affect the tourism industry. In Barbados, for example, 70 per cent of the hotels are located within 250 m of the high water mark. This suggests that many hotels are almost exclusively within the 1 in 500 and 1 in 100 inundation zones[11], placing them at risk of major structural damage (UNFCCC 2007a).

Agriculture

Despite the importance of agriculture in countries like Belize, Cuba, Dominica, and Jamaica, where agriculture is one of the key economic sectors, in the region the scale of this sector cannot be compared to that in larger countries. Dominican Republic is the main producer of rice in the Caribbean. Rice is also an important income source in Guyana and Belize (Goverment of Guyana 2002, Goverment of Belize 2002).

In Jamaica, agriculture produces 7.3 percent of gross domestic product (GDP), representing approximately 12 percent of foreign earnings, and employs approximately 25 percent of the population (Goverment of Jamaica 2000). Methane emissions are far lower than CO_2 emissions and NO_2 emissions are even smaller. Livestock farming in the region is also mainly subsistent. Table 4 summarizes the possible impact of climate change on economic activities that are dependent on the natural resource base.

11 Inundation zone is the area that normally carries water adjacent. Inundation zones may be determined by projection of the anticipated volume of water (e.g., runoff from the "base" storm, storage capacity of the dam that may fail, or excess runoff not conducted by a storm water system).

Table 4: How climate change affects key economic sectors in the region through their natural resource base

Issue or resource vulnerable to climate change	Potential effect of climate change	Sectors at greatest risk	Economic relevance
Freshwater availability	Reduced precipitation; increased evaporation and saline intrusion from sea-level rise.	Water resources, agriculture, and forestry.	Water supply is expected to be a bottleneck for economic activity and serious health concern.
Degradation of marine and coastal ecosystems	Sea-level rise and changes in sea temperature can affect important ecosystems such as mangroves, fishing grounds, and coral reefs.	Tourism, agriculture, and forestry	Most tourism activities are located in the coastal zone. Significant capital investment assets and infrastructure could be affected.
Coastal flooding	Sea level rise will result in flooding of low-lying coastal areas.	Tourism, agriculture, and forestry	Most tourism activities are located in the coastal zone. Significant capital investment assets and infrastructure could be affected.
Climate	Climate change may increase extreme events such as precipitation intensity, tropical storms, or droughts.	Multisectorial	The cost of hurricanes and other natural disasters in the Caribbean region, estimated at several hundred million dollars during the last decade, may increase.

Source: CARICOM Secreteriat, World Bank, OAS and RPIU 2002

1.2.4 Energy

Most CO_2 emissions in the region result from fossil fuel use and the region relies heavily on imported oil as its energy source and transport fuel (Tables 5, 6 and Figure 2). Some countries, for example Barbados and Trinidad and Tobago, also draw on their own supplies of oil, bitumen and natural gas (Goverment of Barbados 2001). The use of charcoal and other forest derived fuel products is not widespread in countries in the region, although charcoal is commonly produced and used in Haiti (Goverment of Haiti 2001).

Table 5: The Caribbean GHG emissions (excluding land use, land-use change and forestry) (Gg)

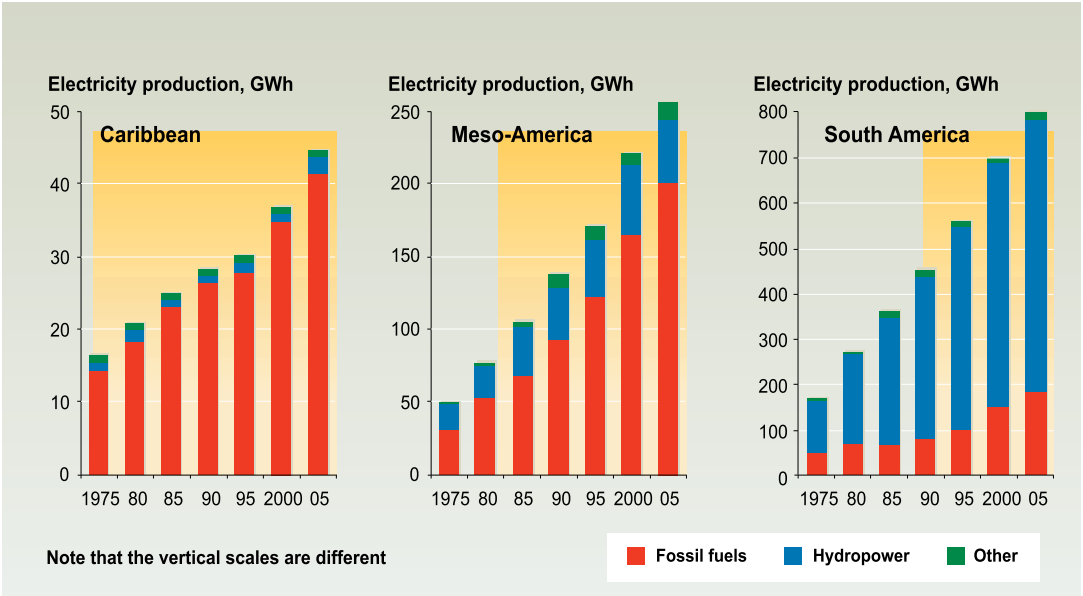
Party	CO_2	CH_4	N_2O
Antigua and Barbuda	288.30	4.67	0.01
Bahamas	1 866.20	1.00	1.00
Barbados	1 913.38	85.12	0.16
Belize	598.07	265.04	0.55
Cuba	23 508.14	445.85	16.94
Dominica	76.53	2.98	0.04
Dominican Republic	18 416.75	230.33	9.75
Grenada	135.00	70.02	0.00
Guyana	1 445.80	42.15	1.21
Haiti	156.77	126.19	7.50
Jamaica	8 561.00	58.17	343.36
Saint Kitts and Nevis	70.89	2.83	12
Saint Lucia	268.59	28.37	0.07
Saint Vincent and the Grenadines	95.07	2.97	0.72
Suriname	4 150	41	12
Trinidad and Tobago	14 987.00	55.54	0.76

Source: UNFCCC 2005c, and the focal point for Dominican Republic.

Apart from Trinidad and Tobago, the Caribbean is not a producer of fossil fuels and is, therefore, heavily dependent on imported fuels. Although Cuba is also a producer - four million tonnes by the end of 2007 - that amount only represents half the country's oil needs. As a result, Cuba is also dependent on oil imports (Ahora 2008).

Energy is produced mainly through burning fossil fuel products such as gas/diesel oil and residual fuel oil (bunker "C") (Figure 2). Liquefied petroleum gas (LPG) is used for cooking while gasoline (petrol) and diesel oil are used for transportation. These account for 90 per cent of the total carbon dioxide emissions in the region. Increased imports of used motor vehicles because of poor public transportation, trade liberalization and increased demand, have not only increased CO_2 emissions, but also have placed a further strain on the current account balance. Local transportation, manufacturing industries, commercial and residential buildings, are other users of fossil fuels, together with agriculture and forestry, that contribute insignificant amounts of carbon dioxide (Tables, 5 and 6, Figure 3).

Figure 2: Sources of electricity in Latin America and the Caribbean



Sources: UNEP Latin America and the Caribbean Enviromental Outlook, 2003; World Development Indicators 2008 (data for 1995-2005)

Table 6: Carbon Dioxide Emissions from the Consumption of Energy*

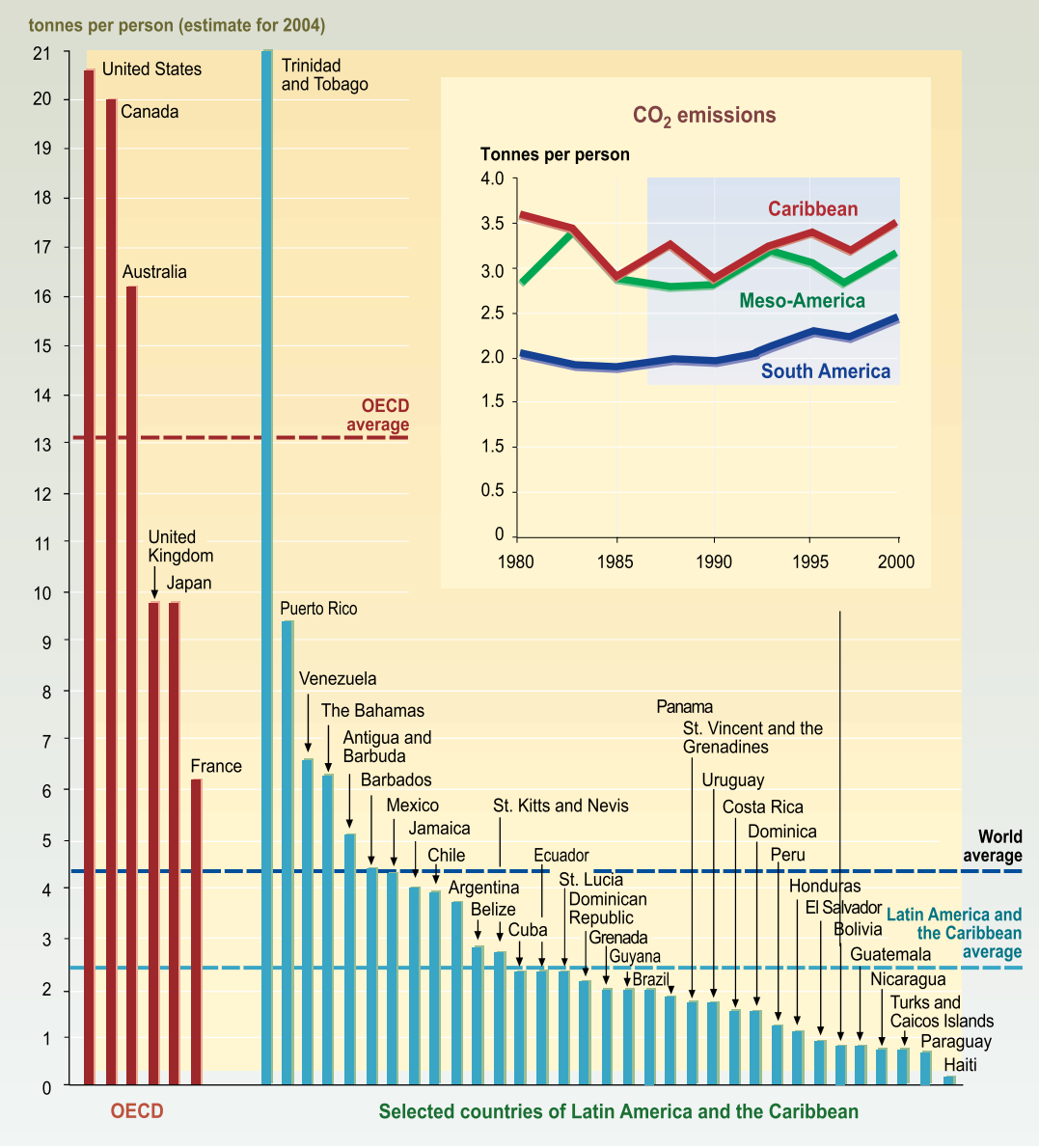
(Million Metric Tons Carbon Equivalent)

Region/ Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Antigua and Barbuda	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.14	0.16	0.16
Aruba	0.16	0.25	0.25	0.25	0.26	0.26	0.26	0.28	0.28	0.28
The Bahamas	0.97	0.96	1.09	0.98	0.95	0.93	0.92	1.13	1.15	1.11
Barbados	0.29	0.39	0.40	0.41	0.46	0.45	0.45	0.46	0.31	0.39
Belize	0.07	0.12	0.12	0.12	0.18	0.23	0.22	0.23	0.25	0.25
Cuba	8.19	9.11	8.84	9.04	8.91	9.01	9.21	8.99	8.94	8.99
Dominica	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
Dominican Republic	3.14	3.31	3.43	3.88	4.78	4.64	5.09	5.29	4.90	4.85
Grenada	0.05	0.06	0.05	0.05	0.03	0.05	0.06	0.06	0.07	0.07
Guyana	0.28	0.30	0.39	0.41	0.46	0.47	0.47	0.46	0.41	0.43
Haiti	0.30	0.39	0.36	0.40	0.41	0.45	0.46	0.46	0.47	0.48
Jamaica	2.73	2.86	2.95	3.0	2.93	2.95	3.02	3.13	3.14	3.15
Netherlands Antilles	3.09	3.27	3.26	3.18	3.15	3.17	2.92	2.91	2.94	3.01
Saint Kitts and Nevis	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04
Saint Lucia	0.05	0.06	0.06	0.06	0.09	0.09	0.10	0.10	0.10	0.10
Saint Vincent and the Grenadines	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
Suriname	0.40	0.41	0.42	0.42	0.42	0.46	0.48	0.50	0.52	0.51
Trinidad and Tobago	6.58	6.98	6.94	7.13	7.47	8.15	8.38	8.08	8.83	10.41
Caribbean	122.54	28.68	28.78	29.59	30.74	31.57	32.29	32.34	32.59	34.31
North America	1,724.97	1,755.22	1,772.55	1,793.58	1,844.64	1,818.35	1,836.69	1,859.15	1,894.06	1,905.76
World Total	6,144.69	6,264.30	6,245.69	6,351.71	6,477.55	6,548.60	6,694.35	7,030.86	7,414.32	7,688.93

* Consumption of Petroleum, Natural Gas, and Coal and Flaring of Natural Gas

Source: Energy Information Administration 2005

Figure 3: CO_2 emissions per person in Latin America and the Caribbean compared to world and OECD average emissions



Source: World Bank's World Development Indicators 2008 and US EIA

Several Caribbean SIDS are undertaking actions to reduce GHG emissions through implementation of various mitigation measures (Box 3).

Box 3: Jamaica Policy Recommendations (from the Energy Policy) for mitigation.

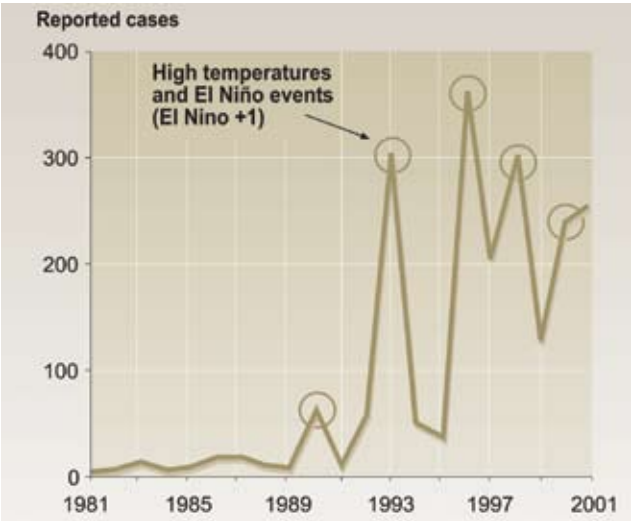
- Contribution from renewable sources to the electricity sector will be increased from the current level of 6% to 10 % by 2010 and to 15% by 2020.
- Tax policies will be designed to encourage development of the renewable energy sector.
- The Government will encourage the local financial sector to provide funding
- The Government will encourage the development of a domestic industry to produce solar systems and biogas technologies
- Through existing national institutions, the Government will facilitate low cost funding to implement solar heating solutions at household and institutional levels.
- The government will strengthen the legislative and regulatory framework and establish appropriate protocols to help the sector to develop.

Source: Barnaby 2007

1.2 5 Health

Threats to health posed by extreme weather events in the Caribbean include insect- and rodent-borne diseases, such as dengue (Figure 4), leptospirosis, malaria and yellow fever; water-borne diseases, including schistosomiasis, cryptosporidium and cholera; food-borne diseases, including diarrhoea, food poisoning, salmonellosis and typhoid; respiratory diseases, including asthma, bronchitis and respiratory allergies and infections; and malnutrition resulting from food production or distribution disruptions (UNFCCC 2007a).

Figure 4: Dengue fever incidence (Trinidad and Tobago)

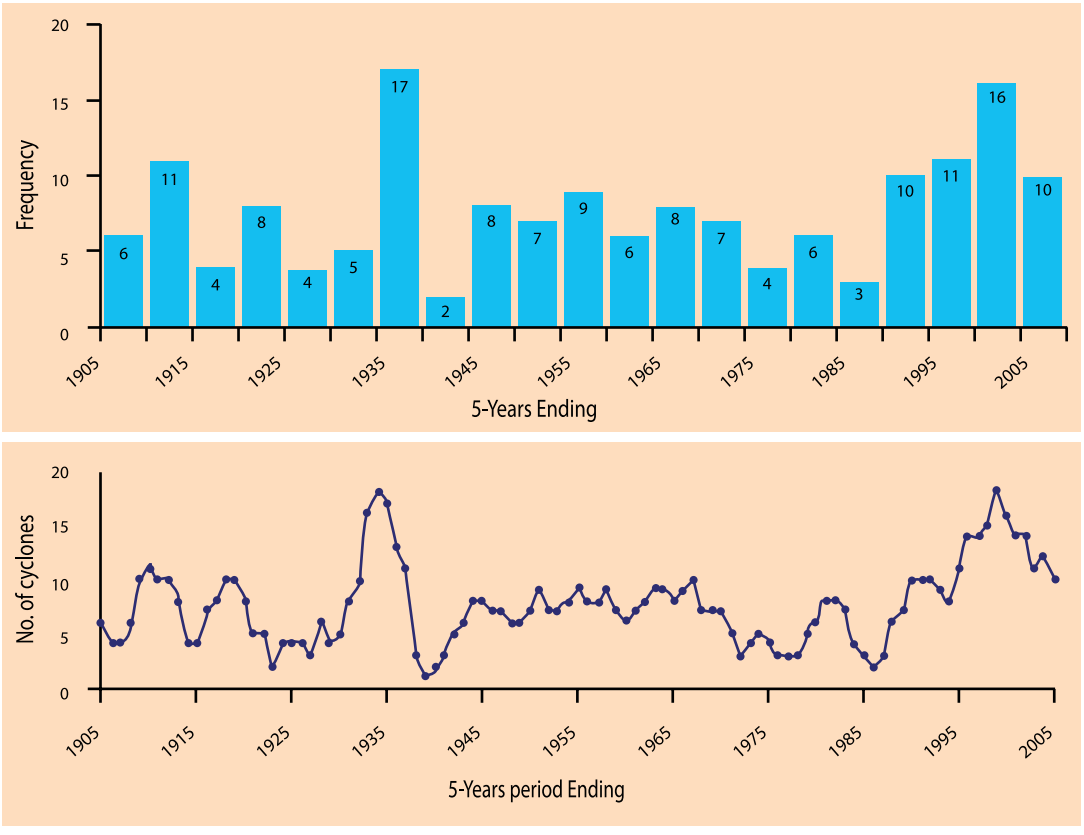


Source: UNEP/GRID - Arendal 2005

1.2.6 Natural Disasters.

Natural disasters and unfavourable weather have also caused major damage to infrastructure and have further increased economic pressures. For example, in September 1995, Hurricane Luis devastated Antigua and Barbuda; this was followed within a week by Hurricane Marilyn, which brought further damage to the country. Virtually all the major tourism facilities located along the coast were ruined and resulted in closures and lost revenue. The number of tourists visiting the country following those hurricanes decreased by 17%, and approximately 7 000 persons lost their jobs. Data indicate that the total cost of the damage amounted to 30.49 per cent of the GDP at factor cost in 1994 (Goverment of Antigua and Barbuda 2001). In 1995, 100 per cent of Dominica's economically important banana crop was lost due to hurricanes Luis, Marilyn, and Iris. Dominica also suffered major coastal damage from these hurricanes. (Commonwealth of Dominica 2001).

Figure 5a: 5-year Distribution of tropical Cyclones of at least Tropical Storm Intensity



Source: Caribbean Meteorological Institute/CARSEA

In 2004 Hurricane Ivan resulted in losses amounting to 200 per cent of the GDP of Grenada (Box 4). Also in 2004, in Haiti Hurricane Jeannie left 2.754 people dead, 298 926 suffering negative effects, and caused extensive destruction of property and livelihoods (UNEP 2005).

Box 4: Grenada and Hurricane Ivan 2004

- Twenty-eight people dead; the most vulnerable people died –70% of the deceased were over 60 years of age.
- Impact in terms of GDP: 212%.
- Ninety-two per cent of forest area and watersheds destroyed
- Tourism: significant damage to 70% of buildings and stocks; direct damage to sector was EC$17 million; indirect EC$4 million[1],.
- Ninety per cent of nutmeg trees uprooted, and 90 per cent of short-term cash crops wiped out.

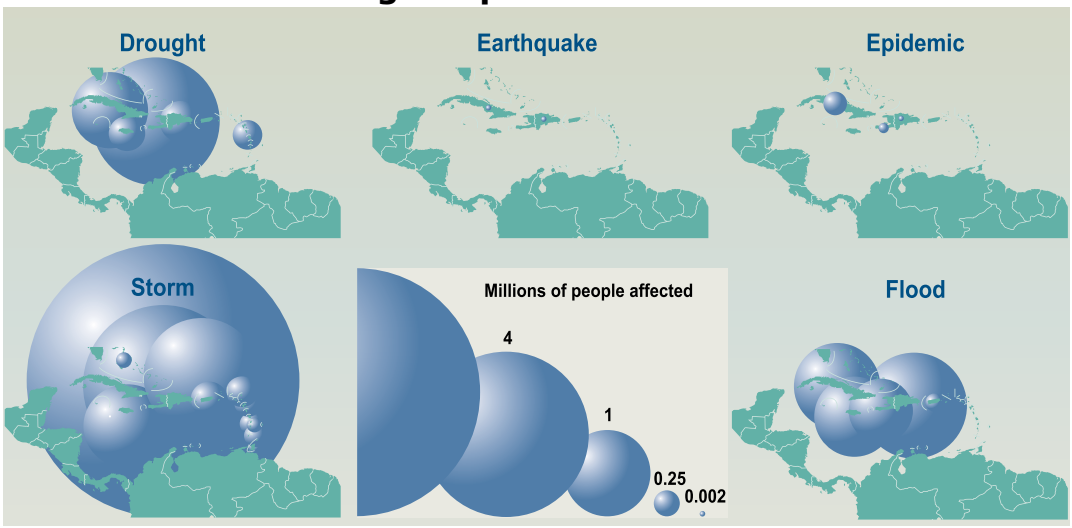
Source: Binger 2007

In August 2007, Hurricane Dean caused 42 fatalities - 39 direct, 3 indirect - and damage of US $3.8 billion (2007), affecting St. Lucia, Martinique Dominica, Puerto Rico, Dominican Republic, Haiti, Jamaica, Cayman Islands, Belize, Mexico, and some regions in Central America. Most of the natural disasters were climate related: floods; drought; landslides; and hurricanes (Figure 5a). There has been a noticeable upward trend in losses, particularly in the past two decades (Trotz 2004).

In 2008, since the 15th August 2008, the Caribbean region has been affected successively by the tropical storm Fay, hurricanes “Gustav”, “Hanna” and “Ike” that claimed more than 350 lives so far, affecting more than 2,8 million persons and damaging more than 600,000 houses while assessments are still on going. In Cuba, some 500,000 houses were damaged of which 63,000 result totally destroyed. The infrastructure and the agriculture have sustained significant damage. As a consequence of these impacts, the vulnerability throughout the Caribbean has increased dramatically (OCHA, 2008).

Figures 5(b) and 5(c) illustrate the number of people affected and the number of people killed by natural disasters in the Caribbean during the period 1950-2007.

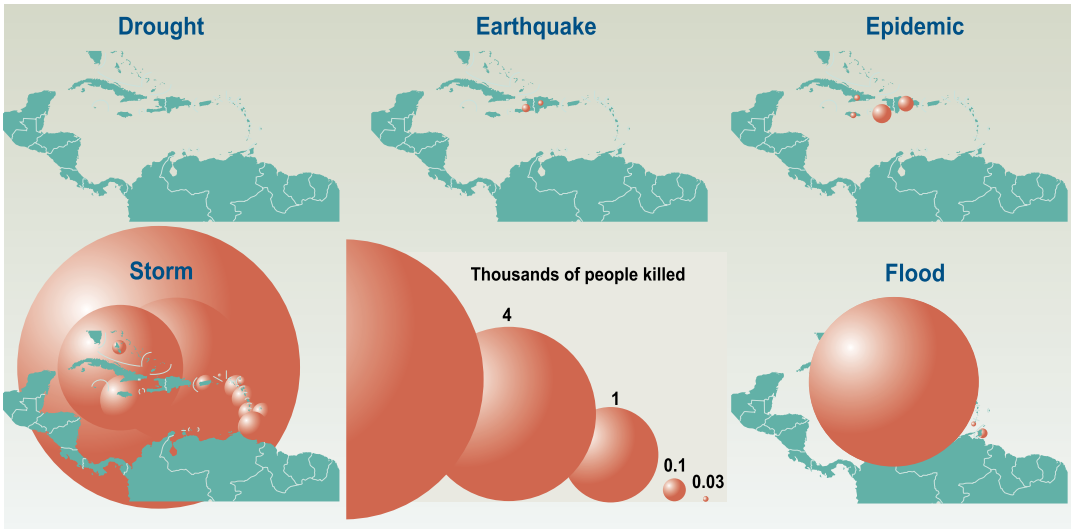
Figure 5b: Caribbean Natural Disasters, People affected during the period 1950-2007



Data covers 23 countries (island territories) of the caribbean
Source: www.em-dat.net The OFDA/CRED International Disaster Database. Universite Catholique de Louvain, Brussels, Belgium

Figure 5b: Over 26,000,000 people were affected by natural disasters such as droughts, earthquakes, epidemics, storms and floods occurred in the Caribbean, between 1950 – 2007. Storms alone produced the highest numbers of affected people (approximately 18,600,000).

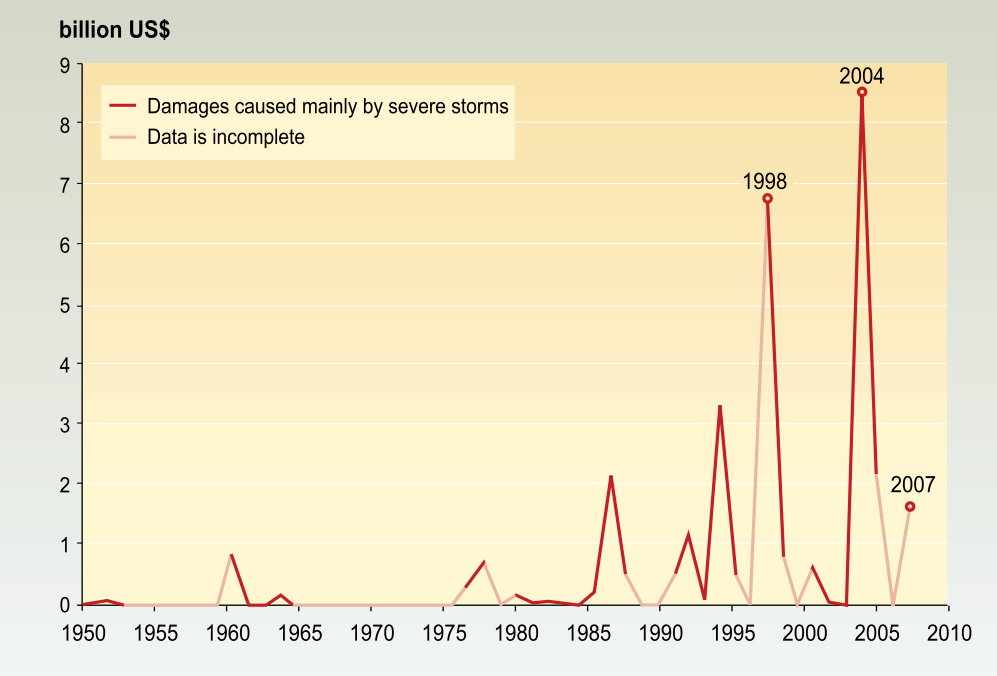
Figure 5c: Caribbean Natural Disasters, People killed during the 1950-2007



Data covers 23 countries (island territories) of the Caribbean
Source: www.em-dat.net The OFDA/CRED International Disaster Database. Universe Catholique de Louvain , Brussels, Belgium

Figure 5c: Almost 22,000 people were killed by natural disasters such as droughts, earthquakes, epidemics, storms and floods occurred in the Caribbean, between 1950 – 2007. Storms alone produced the highest numbers of death (almost 16,000).

Figure 5d: Natural disaster economic damages in the Caribbean

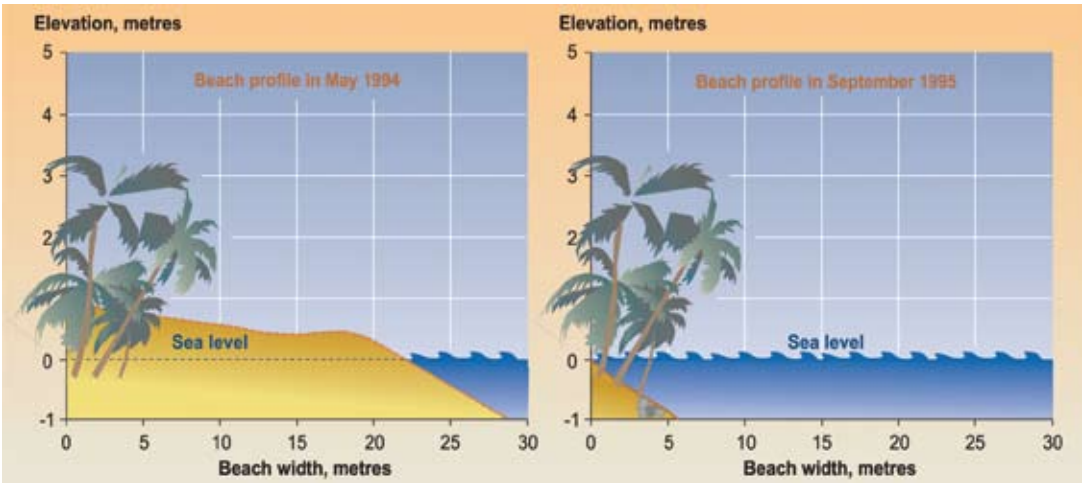


Source: www.em-dat.net The OFDA/CRED international Disaster Database. Universite Catholique de Louvain, Brussels, Belgium

Figure 5d shows that economic damages due to natural disasters in the Caribbean have increased between 1950-2007. The highest economic losses were experienced in 2004 (over US$8,000 millions).

These phenomena have put a huge amount of the region's resources at risk, including coastal infrastructure, human settlements, utilities, coastal ecosystems (e.g. mangroves, seagrass beds, and coral reefs) as shown in figure 6, and socioeconomic sectors (tourism, agriculture, water, health) .

Figure 6: Changes to Coconut Beach (Dominica) after the 1995 huricane season



Source: UNEP/GRID Arendal 2005

1.3 Greenhouse Gas emissions and sinks

The Small Island Developing States of the region are responsible for less than 1 per cent of the total annual global emissions of GHGs (Moore, 2001). Most of these countries do not have extensive industrial sectors and though agriculture remains very important regionally, it is largely subsistence.

Most of the CO_2 emissions in the region result from fossil fuel use. As noted in earlier sections of this report, the region relies heavily on imported oil. Some countries such as Barbados and Trinidad also draw on their own supplies of oil, bitumen and natural gas. The use of charcoal and other forest derived fuel products are not widespread in the countries of the region, though charcoal is commonly produced and used in Haiti.

Despite the importance of agriculture at the national level, regionally it is not of a scale comparable to that of larger countries. Methane emissions are far less than CO_2 emissions and NO_2 emissions smaller still. Regionally livestock farming is also mainly subsistent though rice is produced in Guyana and Belize.

A few of the countries in the region remain highly forested and removals of CO_2 substantially exceed emissions in a number of cases. Most notable are the large tracts of forest in Belize and Guyana, as indicated in Chapter One. The conversion of forested areas contributes to increased CO_2 emissions, being essentially a loss in sink capacity. Deforestation and land degradation is a serious issue in Haiti; such rates of forest removal have not yet been seen in other countries of the region. The combination of poor agricultural practices, deforestation and climatic changes due to rising global temperatures could lead to severe land degradation and exacerbate the socio-economic impacts of climate change.

1.4 A future of growing vulnerability

Economic vulnerability assessments consistently identify small states, sometimes more specifically SIDS, as being more economically vulnerable than larger states. The Caribbean's future is one in which all existing meteorological models, without exception, predict that the region will experience significant negative impacts from climate change; and all economic models say small economies are very vulnerable. The Caribbean is, therefore, facing a future of growing vulnerability and challenges to its survival.

According to the UNFCCC, the following is a possible manifestation of the impact of climate change:

- A shortening of the sugarcane growing season in Guyana would result in an acceleration of maturation and would reduce yields by 29.8 per cent.

- In St. Kitts and Nevis the climate would be too dry for rain-fed agriculture making it economically unfeasible and there would be a 20 per cent decrease in productivity in St. Vincent and the Grenadines.

- Mangrove accretion on land may or may not be able to keep pace with rising sea levels, depending on the composition of the forest, tidal range and sediment supply. Three per cent of Cuba's mangrove forests would be lost with a one meter rise in sea level. The same rise in sea level , it is predicted, would cause a complete collapse of the Port Royal mangrove wetland in Jamaica because this system has shown little capacity to migrate over the last 300 years. A 50 cm rise in sea level could lead to 60 per cent of beaches in some areas of Grenada being lost (UNFCCC 2007a).

The implications of a rising sea level and changing weather patterns could have particularly disastrous consequences for the Caribbean region. The biophysical and socio-economic impacts of climate change and sea level rise, such as beach erosion, more frequent flooding and more droughts, would have severe implications for the livelihood and survival of the region's population. Every facet of Caribbean life would be affected and would put an even greater strain on its limited natural resources, raising the question of what course Caribbean countries should take to mitigate the consequences of climate change and sea level rise.

Action can not be delayed. A recent projection indicated that the Caribbean's annual cost of inaction is projected to total $22 billion annually by 2050 and $46 billion by 2100 (Table 7). These costs represent 10 percent and 22 percent respectively, of the current Caribbean economy. (Bueno et al. 2008).

This projection is based in three categories of effects:

- Hurricane damages, extrapolated from average annual hurricane damages in the recent past;
- Tourism losses, assumed to be proportional to the current share of tourism in each economy; and
- Infrastructure damages, due to sea-level rise (exclusive of hurricane damage), which are projected as a constant cost per affected household.

Table 7: Caribbean Region-Cost of inaction (High-impact minus low impact Scenarios)

Total Caribbean	Cost of Inaction ($US Billions)			
	2025	2050	2075	2100
Storms	$ 1.1	$ 2.8	$ 4.9	$ 7.9
Tourism	1.6	3.2	4.8	6.4
Infrastructure	8.0	15.9	23.9	31.9
Total	$ 10.7	$ 21.9	$ 33.7	$ 46.2
% **Current GDP**	**5.0%**	**10.3%**	**15.9%**	**21.7%**

Source: Tufts University 2008. Amounts in 2007 dollars; percentages bassed on 2004 GDP

Chapter II

SIDS, the Caribbean Region and the International Political Framework for Climate Change

Although the most compelling evidence of the phenomena has been produced in recent years, climate change issues can be traced back over more than two decades of international political debate. Some key moments are reflected in the following sections.

2.1 The World Climate Conferences

The First World Climate Conference, sponsored by the WMO and a number of other international bodies, was held in February 1979 in Geneva. Being essentially a scientific conference, it was attended by scientists from a wide range of disciplines, and touched on issues such as climate data, climate topics, integrated impact studies, and research on climate variability and change.

This conference eventually led to the establishment of the World Climate Programme, set up under the joint responsibility of WMO, UNEP, and the International Council of Scientific Unions (ICSU). It is comprised of four World Climate Programmes (WCP): the World Climate Data Programme, the World Climate Applications Programme, the World Climate Research Programme, and the World Climate Impact Programme.

The Second World Climate Conference was held on 29 October to 7 November 1990, again in Geneva. It was an important step towards the establishment of a global climate treaty and had a higher political connotation than the first conference, with the objective to review the WCPs set up by the first conference. The IPCC first assessment report had been completed in time for this conference.

The Ministerial Declaration of the conference highlighted a number of principles that had emerged in international climate discussions, including the concept of climate change as a common concern of humankind, the principle of equity and the common but differentiated responsibility of countries at different levels of development, the concept of sustainable development, and the precautionary principle.

The Conference also called for elaboration of a framework treaty on climate change and the necessary protocols - containing real commitments and innovative solutions - in time for adoption by the UN Conference on Environment and Development (UNCED) in June 1992. It is important to note that AOSIS was established during this Conference, and has since played a central role in shaping international policy on climate change.

2.2 Evolution of Adaptation under The United Nations Framework Convention on Climate Change (UNFCCC)

The UNFCCC is a legally binding treaty, resulting from years of international lobbying efforts. It addresses critical problems affecting the global commons, culminating in the Rio Conference in 1992. The Convention was negotiated and signed by 165 states in less than three years, and entered into force on 21 March 1994 (UNFCCC, 2008a).

The objectives of the UNFCCC are to:

- Stabilize "greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system." It directs that such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure food production is not threatened and to enable economic development to proceed in a sustainable manner.
- Obtain specific commitments from the Organization for Economic Cooperation and Development (OECD) countries as well as 12 "economies in transition" (Central and Eastern Europe and the former Soviet Union) to limit greenhouse gas emissions and enhance natural sinks, such as forests.; and
- Assist governments to implement national programmes to reduce emissions. It creates a "subsidiary body" for "scientific and technological advice" (SBSTA) to help governments decide what to do next.

The COP Bureau consists of 11 members: two are nominated by each of the five UN regional groups and one place is reserved for a representative of SIDS.

AOSIS countries worked intensively to reach a satisfactory wording of the objective of the Climate Convention. AOSIS submitted a draft protocol to the first COP to the Climate Convention in Berlin in April 1995. This protocol, "AOSIS Protocol" as it is now called, became a centrepiece of continued international negotiations on climate policy. The protocol for example placed industrialized countries (Annex I Parties) on a trajectory of decreasing emissions of CO_2 and other GHGs by establishing the goal of a 20 percent reduction by the year 2005, using the level in 1990 as baseline.

Other key features of the protocol was setting targets and timetables for reduction of other GHGs in phases, as well as establishing a co-ordination mechanism to facilitate international cooperation on specific economic, administrative and other policies and measures to implement the Protocol's objective.
Parties to the Convention agree to take climate change into account in such matters as agriculture, energy, natural resources, and activities involving seacoasts. They agree to develop national programmes to slow climate change.

The Convention encourages the transfer of technology and cooperation to reduce greenhouse gas emissions, especially from energy, transport, industry, agriculture, forestry, and waste management, which together produce nearly all greenhouse gas emissions attributable to human activity.

Each country that is a Party to the Convention must also develop a greenhouse gas "inventory", listing its national sources (such as factories and transport) and "sinks" (forests and other natural ecosystems that absorb greenhouse gases from the atmosphere). These inventories will have to be updated regularly and made public. The information they provide on activities that release GHGs, and the emitted quantities of each gas, will be essential to monitor changes in emissions and determine the effectiveness of measures taken to control emissions.

Specific commitments in the treaty relating to financial and technological transfers apply only to 24 developed countries. They agree to support climate change activities in developing countries by providing financial support above and beyond any financial assistance they already provide to these countries. To this end, decisions taken under the 2001 Marrakech Accords (COP 7) established the Special Climate Change Fund (SCCF), the Least Developed Countries Fund (LDCF), and an Adaptation Fund under the Kyoto Protocol (Box 5).

Box 5: Funding of adaptation under UNFCCC

BThe Special Climate Change Fund (SCCF)

The SCCF aims at supporting activities in the following areas: (i) adaptation; (ii) technology transfer; (iii) energy, transport, industry, agriculture, forestry and waste management; and (iv) economic diversification. Adaptation activities to address the adverse effects of climate change have top priority for funding under the SCCF.

The Least Developed Countries Fund (LDCF)

The LDCF was established to support a work programme to assist LDC Parties undertake out, inter alia, activities to prepare and implement NAPAs.

The Adaptation Fund under the Kyoto Protocol

The Adaptation Fund was established to finance concrete adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol and it will be financed from the share of proceeds of the clean development mechanism (CDM) and other sources.

12 A Decision at CMP 3, Bali, December 2007, decides that developing country Parties to the Kyoto Protocol that are particularly vulnerable to the adverse effects of climate change are eligible for funding from the Adaptation Fund to assist them in meeting the costs of adaptation; and that the Adaptation Fund shall finance concrete adaptation projects and programmes that are country driven and are based on the needs, views and priorities of eligible Parties.

All parties must give an account, in a report called "National Communication". of their actions to address climate change and adapt to its effects. The time frame for the submission of their initial national communications, including emission inventories, is less restricted for Annex I Parties than for non-Annex I Parties - including SIDS - and is contingent on funding being received. The Global Enviroment Facility (GEF), as an operating entity of the financial mechanism of the Convention, provides financial assistance in accordance with guidance provided by the Conference of the Parties (COP) to non-Annex I Parties through its implementing agencies (UNDP, UNEP and the World Bank). Some bilateral agencies also provide financial and technical assistance to many non-Annex I Parties in preparing their national communications.

The 16 independent states of the Caribbean have already submitted their First National Communications to the UNFCCC and are starting to prepare their Second National Communications (Table 8).

Table 8: First National Communication Submissions by the Caribbean countries

Country	Year
Antigua and Barbuda	2001
Bahamas	2001
Barbados	2001
Belize	2002
Cuba	2001
Dominica	2001
Dominican Republic	2003
Grenada	2000
Guyana	2002
Haiti	2002
Jamaica	2000
St Kitts and Nevis	2001
St Lucia	2001
St Vincent and the Grenadines	2000
Trinidad and Tobago	2001
Suriname	2006

Source: UNFCCC web site. Consulted in August 2008

With the First National Communication, countries have identified critical vulnerabilities to climate change and recommended adaptation options to address them. These are expected to be prepared under the Second National Communication.

The Delhi Ministerial Declaration adopted in 2002 at COP 8 stated that adaptation is important for all Parties, but especially so for Least Developed Countries and SIDS.

At the COP 10 in Buenos Aires (2004) a Programme of Work on Adaptation and Response Measures was adopted, and at SBSTA 25 Parties adopted conclusions relating to the "Five-year programme of work on impacts, vulnerability and adaptation to climate change".

This five-year programme of work was the result of negotiations carried out by SBSTA on the scientific, technical and socio-economic aspects of impacts, vulnerability and adaptation to climate change. It was adopted by COP 11 (Montreal, November/December 2005) in decision 2/CP.11, and subsequently, COP 12 (Nairobi 2006) decided to rename the five-year programme of work the "Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change" (Box 6).

Box 6: The Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change

Objective

- To assist countries, in particular developing countries, including the least developed countries and small island developing states, to improve their understanding and assessment of impacts, vulnerability and adaptation; and
- To assist countries to make informed decisions on practical adaptation actions and measures to respond to climate change on a sound, scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

Expected outcomes

- Enhanced capacity at international, regional, national, sectorial and local levels to further identify and understand impacts, vulnerability, and adaptation responses, and to select and implement practical, effective and high priority adaptation actions;
- Improved information and advice to the Conference of the Parties (COP) and its subsidiary bodies on the scientific, technical and socio-economic aspects of impacts, vulnerability and adaptation, including facilitating the implementation of decision 1/CP.10, where relevant;
- Enhanced development, dissemination and use of knowledge from practical adaptation activities;
- Enhanced cooperation among Parties, relevant organizations, business, civil society and decision makers, aimed at enhancing their ability to manage climate change risks;
- Enhanced integration of actions to adapt to climate change with those to achieve sustainable development.

Source: UNFCCC 2008b

The Bali Action Plan adopted at COP 13 – December 2007- launched a comprehensive process which includes a package of action on adaptation, including, inter alia, consideration of international cooperation to support urgent implementation of adaptation actions, including through vulnerability assessments, prioritization of actions, financial needs assessments, capacity-building and response strategies, integration of adaptation actions into sectoral and national planning, specific projects and programmes, means to incentive the implementation of adaptation actions, and other ways to enable climate-resilient development and reduce vulnerability of all Parties, taking into account the urgent and immediate needs of developing countries that are particularly vulnerable to the adverse effects of climate change. The special case of Small Island Developing States is referred.

2.3 The Barbados Programme of Action

The Small Island Developing States Programme of Action (SIDS/POA) had its origin in the United Nations Conference on Environment and Development (UNCED) in 1992, also known as the Rio or Earth Summit. At this conference, in Chapter 17 of Agenda 21, the international community recognized that small islands are a special case and an important part of the diversity of nations. As a result, nations agreed to hold a Global Conference on the Sustainable Development of Small Island Developing States that was held in Barbados in 1994 (UN 1994).

The Conference adopted the Barbados Declaration which states, with regard to climate change, that "While Small Island Developing States are among those that contribute least to global climate change and sea level rise, they are among those that would suffer most from the adverse effects of such phenomena and could in some cases become uninhabitable. Therefore, they are among those particularly vulnerable States that need assistance under the United Nations Framework Convention on Climate Change, including adaptation measures and mitigation efforts" (UN 1994).

The vulnerability of SIDS to climate change, climate variability and sea-level rise featured prominently in the Barbados Programme of Action (BPoA). Due to the concentration of population, agricultural land and infrastructure in the coastal zones, any rise in sea level will have significant and profound effects on their economies and living conditions, threatening the very survival of certain low-lying countries. Damage to coral reefs, affectation to subsistence and commercial fisheries production, saline intrusion are also highlighted, as

well as the increased frequency and intensity of the storms that may result from climate change. The United Nations Millennium Summit (2000) and the General Assembly Twenty-Second Special Session both recognized that urgent action was required to address the special needs of SIDS by implementing the BPoA "rapidly and in full"(UN 2000). The Summit also urged the international community to ensure that, when developing a vulnerability index, the special needs of SIDS be taken into account.

2.4 The birth of the Caribbean Planning for Adaptation to Climate Change (CPACC) project

Requested by CARICOM countries at the Barbados Conference, the Organization of American States (OAS) applied for and received a GEF Project Development Facility (PDF) Grant in August 1995 . A number of Regional Consultation Workshops (Barbados, September 1995; Dominica, January 1996, and St. Kitts, May 1996) as well as national consultations were carried out between October 1995 and February 1996. The result was a proposal for the Caribbean Planning for Adaptation to Climate Change (CPACC) project, which was submitted for funding to the GEF. The participating institutions were: CARICOM, the University of the West Indies, the Caribbean Meteorological Institute, the Institute of Marine Affairs, OECS-NRMU, the World Bank, the Caribbean Development Bank, IOCARIBE, NOAA, UNDP and UNEP/CEP. Among participating counties were: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago (See also Chapter 3).

2.5 The World Summit on Sustainable Development

In 2002, the World Summit on Sustainable Development again highlighted the fact that SIDS are a special case both for the environment and development. Although they continue to take the lead on the path towards sustainable development in their countries, they are increasingly constrained by the interplay of adverse factors clearly underlined in Agenda 21, BPoA, and the decisions adopted at the Twenty-Second Special Session of the UN General Assembly.

The Plan of Implementation of WSSD (Paragraph 38), expresses deep concern that "…all countries, particularly developing countries, including the least developed countries and Small Island Developing States, face increased risks of negative climate change impacts and recognize that, in this context, the problems of poverty, land degradation, access to water and food and human health services remain at the centre of global attention" (UN 2005).

The Plan identifies the need for action to be taken to assist Small Island Developing States to mobilize adequate resources and partnerships to help them to adapt to the adverse effects of climate change, sea level rise and climate variability, consistent with commitments under the United Nations Framework Convention on Climate Change (Para 58 j) (UN 2005).

2.6 The Mauritius Strategy for further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States

In 2004, the Secretary General of the United Nations Commission on Sustainable Development published a review of the progress made in implementing the BPoA, concluding that progress had been "mixed" (UN 2004).

This led to a high-level United Nations meeting in Mauritius in 2005 to review how the BPoA was being implemented, to refine its priorities and incorporate areas that had emerged as being important for sustainable development. The result was the Mauritius Declaration and the Mauritius Strategy for the Further Implementation of the Programme of Action for the Sustainable Development of Small Island Developing States.

The action recommended to be taken by the international community and outlined in the Mauritius Strategy to address the threat posed to SIDS by climate change, reinforces the contents of the BPoA. Action includes developing, transferring and disseminating to SIDS appropriate technologies and practices to address climate change; building and enhancing scientific and technological capabilities (including in SIDS), and enhancing how national, regional and international global atmospheric observing systems are implemented.

2.7 The Kyoto Protocol

At the time of the adoption of the UNFCCC, governments knew that its commitments would not be sufficient to seriously tackle climate change.

At COP 1 (Berlin, 1995), in a decision known as the Berlin Mandate, Parties launched a new round of talks to decide on stronger and more detailed commitments for industrialized countries. After two and a half years of intense negotiations, on 11 December 1997 the Kyoto Protocol was adopted at COP 3 in Kyoto, Japan. The Kyoto Protocol entered into force on 16 February 2005. (UNFCCC 2008c).

The Kyoto Protocol shares the Convention's objective, principles and institutions, but significantly strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions. Only Parties to the Convention that have also become Parties to the Protocol, however (that is, by ratifying, accepting, approving, or acceding to it), are bound by the Protocol's commitments. Individual targets for Annex I Parties are listed in the Kyoto Protocol's Annex B. These add up to a total cut of at least 5% from 1990 levels in the commitment period 2008-2012.

The targets cover emissions of the six main GHGs, namely: Carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); and sulphur hexafluoride (SF6) The maximum amount of emissions (measured as the equivalent in carbon dioxide) that a Party may emit over the commitment period in order to comply with its emissions target is known as a Party's Assigned Amount.

The Protocol includes provisions for the review of its commitments so that they can be strengthened over time. Negotiations on targets for the second commitment period started in 2005.

To achieve their targets, Annex I Parties must put in place domestic policies and measures. The Protocol provides an indicative list of policies and measures that might help mitigate climate change and promote sustainable development. Parties may offset their emissions by increasing the amount of GHGs removed from the atmosphere by so-called carbon "sinks" in the land use, land-use change and forestry sector; however, only certain activities in this sector are eligible. These are afforestation, reforestation and deforestation, and forest management; cropland management, grazing land management and revegetation. GHGs removed from the atmosphere through eligible sink activities generate credits known as Removal Units (RMUs). Any emissions from eligible activities, in turn, must be offset by greater emission cuts or removals elsewhere.

The Protocol also establishes three market based "mechanisms" known as Joint Implementation, the Clean Development Mechanism, and Emissions Trading. These are designed to help Annex I Parties cut the cost of meeting their emissions targets by taking advantage of opportunities to reduce emissions, or increase greenhouse gas removals, that cost less in other countries than in their own. Any Annex I Party that has ratified the Protocol may use the mechanisms to help meet its emissions target, provided that it is complying with its methodological and reporting obligations under the Protocol. However, Parties must provide evidence that their use of the mechanisms is "supplemental to domestic action", which must constitute "a significant element" of their efforts to meet their commitments.

Of these mechanisms only the Clean Development Mechanism (CDM) allows Non-Annex I Parties to participate. According to the CDM modalities, Annex I Parties may implement emissions reducing projects in non-Annex I Parties and use the resulting certified emission reductions (CERs) to help meet their own targets.

To date, only four projects in the Caribbean region have been registered in the CDM mechanism (Table 9).

Table 9: Projects in the Caribbean Region registered in the CDM Mechanism

Registered	Title	Host Party	Other Party	Reductions
19 Mar 06	Wigton Wind Farm Project	Jamaica	Netherlands	52 540
20 Oct 06	El Guanillo Wind Farm	Dominican Republic	Spain	123 916
23 Jun 07	Energas Varadero conversion from open cycle to combined cycle Project	Cuba	Canada	20 004
04 May 08	Guyana Skeldon Bagasse Cogeneration Project	Guyana	Spain	44 733

Note: Reduction measure expressed in tonnes CO_2 equivalent per annum

Source: UNFCCC 2008e

The Caribbean SIDS have ratified the UNFCCC and the Kyoto Protocol, and have been taking steps to meet their obligations through a series of coordinated projects and activities (Table 10).

Table 10: UNFCCC and Kyoto Protocol Ratification Status in the Caribbean

Country	UNFCCC			Kyoto Protocol		
	Signature Signature	Ratification	Entry into force	Signature	Ratification	Entry into force
Antigua and Barbuda	04/06/92	02/02/93	21/03/94	16/03/98	03/11/98	16/02/05
Bahamas	12/06/92	20/03/94	27/06/94		09/04/99	16/02/05
Barbados	12/06/92	23/03/94	21/06/94		07/08/00	16/02/05
Belize	13/06/92	31/10/94	29/01/95		26/09/03	16/02/05
Cuba	12/06/92	05/01/94	05/04/94	15/03/99	30/04/02	16/02/05
Dominica		21/06/93	21/03/94		25/01/05	25/04/05
Dominican Republic	12/06/92	07/10/98	05/01/99		12/02/02	16/02/05
Grenada	03/12/92	11/08/94	09/11/94		06/08/02	16/02/05
Guyana	13/06/92	29/08/94	27/11/94		05/08/03	16/02/05
Haiti	13/06/92	25/09/96	24/12/96		06/07/05	04/10/05
Jamaica	12/06/92	06/01/95	06/04/95		28/06/99	16/02/05
St Kitts and Nevis	12/06/92	08/04/08	07/07/08		08/04/08	07/07/08
St Lucia	14/06/93	14/06/93	21/04/94	16/03/98	20/08/03	16/02/05
St Vincent and the Grenadines		02/12/96	02/03/97	19/03/98	31/12/04	31/03/05
Suriname	13/06/1992	14/10/97	12/01/98		25/09/06	24/12/06
Trinidad and Tobago	11/06/92	24/06/94	22/09/94	07/01/99	28/01/99	16/02/05

Source: UNFCCC 2008d

Chapter III

Responding to Vulnerability and Adaptation Needs in the Caribbean

3.1 SIDS vulnerability and adaptation

The term 'vulnerability' refers to susceptibility to damage from external forces, and has become associated with SIDS because these countries tend to be very exposed to factors outside their control (UNEP 2005).

Vulnerability assessment typically seeks to reach three main goals: to identify the degree of future entity-induced risks (in this case regional climate change and sea-level rise); to identify the key vulnerable sectors and areas within a country; and to provide a sound basis for designing and implementing adaptation strategies. In the case of global climate change, it is significant that all published assessments of the region consistently confirm high vulnerability, and all global assessments have arrived at similar conclusions.

Adaptation may be defined as adjustments of natural or human systems in response to actual or expected climatic stimuli, or their effects or impacts, that moderates harm or exploits beneficial opportunities associated with climate change (IPCC 2001). Adaptation can be spontaneous or planned and can involve enhancing the feasibility of social and economic activities to make them less vulnerable to climate. Autonomous or spontaneous adaptations are considered to be those that take place as a reactive response to climate stimuli. Planned adaptations can either be reactive or anticipatory, i.e. undertaken before the impacts are apparent.

Adaptation can also be either short term or long term. A portfolio of adaptation and mitigation measures can diminish the risks associated with climate change. Responses include (Nurse 2007):

- Purely technical (e.g. infrastructure defences against sea level rise, improved water use efficiency, demand side management through metering and pricing).
- Behavioural (e.g. altered food and recreational choices).
- Managerial (e.g. altered farm practices).
- Policy (e.g. planning regulations, improved building codes).

At their simplest, adaptation activities can be categorized as follows:

- Relocation: shifting current activities or structures to another location.
- Accept Loss: do not implement vulnerability measures and bear the burden of loss.
- Prevention of loss: reduce vulnerability to climate change by engineering or other measures.
- Activity Changes: replace current activities with more sustainable activities.
- Spread losses: distribute the burden of losses through property insurance, government relief and other measures.
- Research and monitoring: to inform the adaptation process, improve knowledge of processes by using data and information and observe trends.
- Public awareness and education: sensitize and increase the population's awareness, including selected target audiences, to obtain their support or change their behaviour.

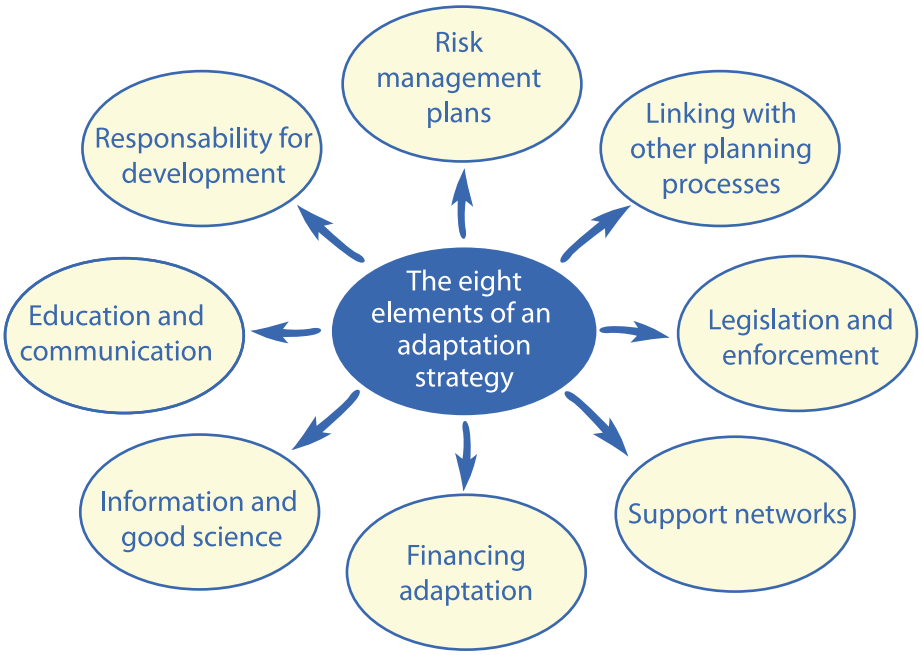
Adaptation has been taking place in the Caribbean region on a local scale through ad hoc individual action. For example, since Hurricane Ivan struck Jamaica it has become a common practice to place concrete blocks on top of zinc roofs to prevent them from being blown away during hurricanes. Practices for coping with coastal erosion can be useful in adapting to rising sea levels; an example can be seen in Playa Rosario in Havana Province, Cuba, where the community has been relocated five kilometres inland because of coastal erosion (UNFCCC 2007a). Many of the adaptation options available to Caribbean countries – e.g. land use planning, Integrated Watershed Management – are also a part of their sustainable development agenda.

However, SIDS have a limited capacity to adapt for a variety of reasons, including inadequate data and technical capacity, weak human and institutional capacities and limited financial resources (UNFCCC 2005a).

3.2 Caribbean adaptation responses

Challenges posed by global climate change have global, regional, national and local dimensions. As pointed out, the region emits a relatively small amount of GHGs. Nevertheless, since it is already experiencing some of the negative effects expected of future climates, it is now time to take action at regional, national and local levels to reduce future vulnerability.

Figure 7: Possible elements of Adaptation Strategy



Source: Thompkins and others 2005

Caribbean countries have adopted various adaptation measures (Figure 7). The following subsection describes relevant activities in this regard.

3.2.1 The Caribbean Planning for Adaptation to Climate Change project (1997- 2001)

In response to the Barbados Programme of Action (See Section 2.3), Caribbean governments approached the Organization of American States (OAS) to request support to develop regional projects aimed at building capacity to adapt to climate change. The OAS and CARICOM jointly organized a series of national and regional workshops to facilitate maximum stakeholder consultation on climate change issues (CARICOM Seretariat 2008a).

The result was a proposal for the Caribbean Planning for Adaptation to Climate Change (CPACC) project, which was submitted for funding to the Global Environment Facility (GEF). CPACC, consisting of four regional projects and five pilot projects, was approved and was granted US$5.6 million. The CPACC project (1997-2001) was implemented by the World Bank, executed by the OAS, and overseen by a Project Advisory Committee chaired by CARICOM. A Regional Project Implementation Unit based in Barbados was responsible for implementing the project.

The goal of the CPACC project was to build capacity in the Caribbean region to adapt to climate change impacts, particularly sea level rise (Table 11). This was accomplished by making vulnerability assessments, adaptation planning, and capacity building activities. Most CARICOM member countries participated in CPACC including: Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, St. Kitts and Nevis, St. Vincent, and Trinidad and Tobago.

Table 11: CPACC main components

Regional Projects	Pilot Projects.
1. Design and establish a sea level/ climate monitoring network. 2. Establish databases and information systems. 3. Inventory of coastal resources. 4. Use and formulate of initial adaptation policies.	1. Coral reef monitoring for climate change (Bahamas, Belize, and Jamaica) 2. Coastal vulnerability and risk assessment (Barbados, Guyana, and Grenada) 3. Economic valuation of coastal and marine resources (Dominica, Saint Lucia, and Trinidad and Tobago). 4. Formation of economic/regulatory proposals (Antigua and Barbuda, and St Kitts and Nevis). 5. National communications (St Vincent and the Grenadines).

Source: MACC

Specific project achievements included:

- Establishing a sea level and climate monitoring system. Eighteen monitoring systems, along with the related data management and information networks, were installed in 12 countries.
- Improved data access and availability. An integrated database to monitor climate change effects was established by using the Inventory for Coastal Resources and by institutionalizing coral reef monitoring (Box 7).
- Increased appreciation of climate change issues at the policy-making level. CPACC enabled more unification among regional parties and better articulation of regional positions for negotiations under the UNFCCC and the Kyoto Protocol.
- Meeting country needs for expanded vulnerability assessment. Pilot vulnerability studies were undertaken in Grenada, Guyana, and Barbados.

- Establishment of coral reef monitoring protocols. This resulted in a significant increase in monitoring and early warning capabilities.
- Articulation of national climate change adaptation policies and implementation plans. Such policies and plans were formulated in 11 participating countries.
- Creation of a regional harmonization network. CPACC developed initial collaborative efforts with a number of existing regional agencies. Cooperation with partners, as well as key players in the insurance and banking sectors

Box 7: Coastal Resources Inventory System – CRIS

The Coastal Resources Inventory System (CRIS) was developed by CPACC as a tool to enable countries to compile the necessary baseline data to execute project activities related to coastal resources sustainable management.

CRIS manages several types of coastal resources data, including physical characteristics, natural environments, and information on the use of coastal areas and resources. The idea behind CRIS is to assist in moving the agencies in each country beyond simple data collection, and to help them to cooperate in establishing GIS-based coastal resource data management and analysis to be used to formulate policies and in decision making. CRIS is an interactive system based on a web-GIS concept, capable of combining data with spatial information such as airborne and satellite imagery. It is addressed to planning agencies and ministries of environment, and has the potential for being used as a multi-layered multi-scenario decision making support tool.

Source: OAS 2004

Before completion of CPACC, the Caribbean region successfully negotiated a CAD $3.5 million grant from the Canadian Climate Change Development Fund of the Canadian International Development Agency (CIDA). This grant supported CPACC's successor, the Adapting to Climate Change in the Caribbean (ACCC) project.

3.2.2 The Adaptation to Climate Change in the Caribbean project (2001-2004)

The Adapting to Climate Change in the Caribbean (ACCC) project, which succeeded the CPACC project, was overseen by the World Bank, with support provided by CARICOM (CARICOM Secretariat 2008b)

This project was designed to sustain activities initiated under CPACC and to address issues of adaptation and capacity building not undertaken by CPACC, thus further building capacity to adapt to climate change in the Caribbean region. ACCC also helped to transform the Regional Project Implementation Unit (RPIU), originally established through CPACC, into a regional legal climate change entity - the Caribbean Community Climate Change Centre (CCCCC) (See Section 3.2.4). It did so by providing the resources to develop a comprehensive business plan for the Centre and a strategy to ensure its financial sustainability.

Box 8: ACCC components

1. Project design and business plan developed for a regional climate change centre.
2. Public education and outreach.
3. Integrating climate change into a physical planning process using a risk management approach to adapting to climate change.
4. Strengthening regional technical capacity, in partnership with the Caribbean Institute for Meteorology and Hydrology (CIMH), the University of the West Indies (Scenario Projection and Establish Climate Change Master's Programme), and the Caribbean Environmental Health Institute, to enhance association between Caribbean and South Pacific small island states.
5. Integrating adaptation planning in environmental assessments for national and regional development projects.
6. Implementation strategies of adaptation in the water sector.
7. Formulating adaptation strategies to protect human health.
8. Adaptation strategies for agriculture and food.
9. Foster collaboration/cooperation with non-CARICOM countries.

Source: CPACC

The results of ACCC included:

- Developing and distributing risk management guidelines for climate change adaptation decision making.
- Political endorsement (by CARICOM) of the business plan and establishing the basis of financial self-sustainability for the CCCCC.
- Developing a guide to assist environmental impact assessment (EIA) practitioners in CARICOM countries to include climate change in the EIA process.
- A draft regional public education and outreach (PEO) strategy (Box 9).
- Successful launch of a Master's Programme in climate change.

- Statistically downscaled climate scenarios developed for Jamaica, Trinidad and Tobago, and Barbados.
- Staff training and development at the Caribbean Institute for Meteorology and Hydrology (CIMH) in climate trend analysis in order to strengthen climate change capacity.
- Dialogue established with the South Pacific Regional Environment Programme (SPREP) and the Pacific Islands Climate Change Assistance Programme (PICCAP) for collaboration on issues related to climate change.
- Pilot projects on adaptation studies in the water, health and agricultural sectors implemented.

Box 9: Regional Public Education and Outreach (PEO) strategy

VISION OF THE STRATEGY:

"Ensure that Caribbean citizens, the private sector and governments are aware of climate change and its potential impacts, and have the knowledge to support and conduct appropriate adaptation responses that enhance the economic and environmental potential of the region"

OBJECTIVES:

- Build awareness of climate change and its impacts in the region.
- Promote policy changes to assist the region to adapt to climate change.
- Establish and strengthen links, capacity and access to information and resources on climate change.

Source: Mc Gann 2007

During ACCC's term, negotiations took place for a third project. The Mainstreaming Adaptation to Climate Change (MACC) project.

3.2.3 The Mainstreaming Adaptation to Climate Change project

Funded by GEF, the main objective of The Mainstreaming Adaptation to Climate Change (MACC) project is to mainstream adaptation to climate change into national development planning (CARICOM Secretariat 2008c) (Figure 8).

The project consists of the following components:

- Component 1: Mainstreaming adaptation to climate change in national development planning and public and private sector strategies.
- Component 2: Supporting the formulation of a regional strategy on adaptation and specific measures of adaptation (demonstration pilots).

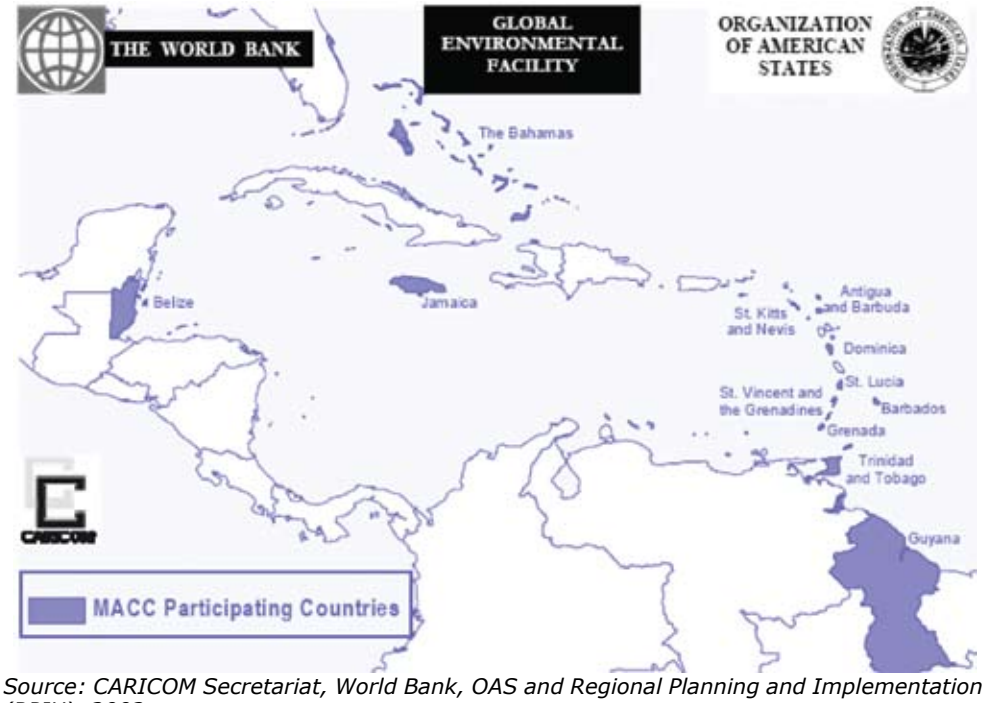
- Component 3: Expanding and strengthening the existing knowledge base to facilitate Global Climate Change impact assessment as a basis for decision making on adaptation.
- Component 4: Public Education and Outreach including Cross-regional dissemination and replication.
- Component 5: Project Management

The MACC project carries out vulnerability assessments for communities at risk, exploring their history and possible climate change impacts in order to design adaptation options with a view to influencing adaptation policies (Figure 9).

Activities under the project include those designed to:

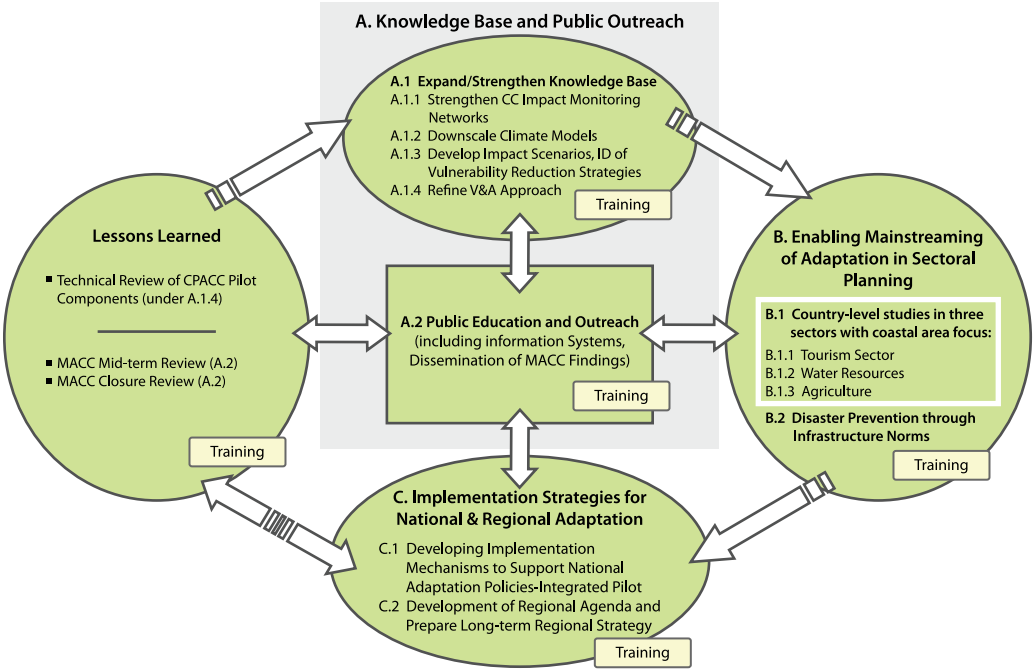
- Predict future regional climate through statistical and dynamic downscaling of global climate models.
- Develop regional climate change scenarios
- Make vulnerability assessments with specific focus on water, agriculture and tourism sectors.
- Develop climate impact scenarios for the selected sectors.
- Identify feasible adaptation options for these sectors.
- Devise strategies to incorporate climate change issues into national development planning.
- Support regional efforts to develop a regional adaptation strategy and implementation plan.
- Implement the regional Public Education and Outreach strategy.

Figure 8



Source: CARICOM Secretariat, World Bank, OAS and Regional Planning and Implementation Unit (RPIU), 2002

Figure 9: Mainstreaming Adaptation to Climate Change (MACC) Project Structure



Source: OAS 2002

3.2.4 The Caribbean Community Climate Change Centre

In July 2002 Caribbean Heads of Government endorsed the creation of a permanent facility in the region to address climate change. The Centre, based in Belmopan, Belize, became functional in December 2004 and is the executing agency for the GEF pilot adaptation project.

The Caribbean Community Climate Change Centre (CCCCC) coordinates the Caribbean region's response to climate change (CARICOM Secretariat 2008d). Officially opened in August 2005, the Centre is the key nucleus for information on climate change issues and on the region's response to managing and adapting to climate change in the Caribbean. Currently, the CCCCC is the executing agency of the MACC Project.

The Caribbean Community Climate Change Centre (CCCCC). Photo: Carlos Fuller

The CCCCC is the official repository and clearing house for regional climate change data, providing climate change-related policy advice and guidelines to the CARICOM Member States through the CARICOM Secretariat. In this role, the Centre is recognized by the UNFCCC, UNEP, and other international agencies as the focal point for climate change issues in the Caribbean. It has also been recognized by the United Nations Institute for Training and Research (UNITAR) as a Centre of Excellence.

The Centre addresses the impact of climate variability and change on all aspects of economic development by providing timely forecasts and analyses of hazardous impacts of both natural and human-induced environment climate changes, and by developing special programmes that create sustainable development opportunities.

The Centre`s activities focus on (Fuller 2007):

- A regional clearing house community-level interface
- A mechanism for continuous environmental scan
- Collaborative initiatives
- Joint-programme development
- A private sector policy advisory service
- Trust fund development

In October 2007, the Climate Change Centre signed a Memorandum of Understanding with the Government of the United Kingdom to facilitate funding for the development of the comprehensive Caribbean Regional Climate Change Strategy, with the purpose of providing the Caribbean Community with a coherent and cohesive policy framework and implementation plan to guide its efforts (Sustainable Development International 2007).

3.2.5 Other adaptations projects in the Caribbean Region

Pilot adaptation project in St. Lucia, Dominica and St. Vincent and the Grenadines

The Special Pilot on Adaptation to Climate Change, supported by the GEF (2007-2011), is being undertaken in Dominica, St. Lucia and St. Vincent and the Grenadines. The project objective is to support these countries to implement integrated pilot adaptation measures that will have a direct influence on adopting policies to promote climate resilient development. It is addressing the climate change impacts on the natural resource base of the region, while focusing especially on biodiversity and land degradation along coastal and near-coastal areas. The project aims is to make efficient and integrated use of the capacity built in past operations, and of limited human and financial resources, to advance by taking practical steps to implement adaptation measures (The World Bank Group 2008).

The Pilot project hopes that reducing the climate change impacts will bring economic benefits to the tourism, fisheries, agriculture and forestry sectors, help to maintain the resource base upon which these economic activities rely, and promote climate resilient sustainable development. While it is still at its early stage of its implementation, the experience gained through the Pilot local activities will assist and inform the policy decision-making and influence how climate resilient sustainable development policies are enacted in the region.

Also, it should be noted that the project provides an opportunity to seek synergies in support of various MEAs and in promoting and facilitating more effective coordination. The project complements the goals of the MACC project and applies the lessons and information provided by the CPACC.

Capacity Building for Stage II[13] *Adaptation to Climate Change in Central America, Mexico, and Cuba*

Central America, Mexico and Cuba are currently serving as the pilot region to prepare adaptation strategies, policies and measures in the context of the UNFCCC. This multi-country effort, funded by the enabling activity window of the UNFCCC financial mechanism, will demonstrate how the policy of adaptation can be integrated into national sustainable development efforts in at least four human systems: water resources, agriculture, human health, and coastal zones. It builds upon the Stage I vulnerability and adaptation assessments of the participating countries as indicated in their First National Communications, enabling them to move on to Stage III Adaptation in accordance with the decision in Article 4.1 of the UNFCCC.

The outputs of the project will also contribute to the preparation of the Second National Communications, and provide relevant information to GEF about the modalities of adaptations projects to be financed by organizing national consultations among stakeholders. Assessments of the existing vulnerability are being finalized, and preparations are being made to assess future vulnerabilities.

3.3 Information Capacity and Capacity building

Strengthening overall capacity on "environmental information" (i.e. observations of the current state, and modelling and forecasting of future states) is crucial to climate change adaptation activities in SIDS, even though such capacity strengthening is only a part of the overall climate change adaptation framework. The following sections examine some of the key capacities in the Caribbean region that are relevant to information on climate change.

13 Decision 11/CP.1 of the Conference of the Parties divides adaptation activities into the following three stages: Stage I Adaptation: "Planning, which includes studies of possible impacts of climate change, to identify particularly vulnerable countries or regions and policy options of adaptation and appropriate capacity building"; Stage II Adaptation: "Measures, including further capacity building, which may be taken to prepare of adaptation as envisaged in Article 4.1 (e)" and Stage III Adaptation: "Measures to facilitate adequate adaptation, including insurance, and other adaptation measures as envisaged in Articles 4.1 (b) and 4.4".

3.3.1 The Caribbean Meteorological Organization

The Caribbean Meteorological Organization (CMO) is a specialized agency of CARICOM, located in Port of Spain, Trinidad and Tobago, that coordinates joint scientific and technical activities on weather-, climate- and water-related sciences in 16 English-speaking Caribbean countries[14] . It has its origin in the British Caribbean Meteorological Service, founded in 1951. Federalization of the Anglo-Caribbean Countries produced the West Indian Meteorological Service, founded in 1958 (CMO 2008).

The objectives of the CMO are to promote and co-ordinate regional activities in the fields of meteorology and allied sciences. The CMO has four branches:

- The Caribbean Meteorological Council is the supreme organ of the Organization and its members are Ministers responsible for meteorology; it meets once a year to define policy for the Organization. The Council issues directions of a general or special character as to the policy to be pursued by the Organization and its organs.
- The Headquarters Unit is located in Trinidad and Tobago and is headed by a Coordinating Director. The functions of the Headquarters Unit include carrying out the decisions of the Council, as well as advising and assisting Member States, in particular those without national meteorological services.
- The Caribbean Institute for Meteorology and Hydrology (CIMH) (See Box 10) is the education, training, and research arm of CMO.
- The Caribbean Meteorological Foundation is a charitable organization whose objective is to promote, through the CIMH, the study of and research on meteorology, hydrology, and associated sciences.

14 The sixteen member countries participating in the CMO are Anguilla, Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St. Kitts/Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, and the Turks and Caicos Islands.

Box 10: The Caribbean Institute for Meteorology and Hydrology

Located in Barbados, the Caribbean Institute for Meteorology and Hydrology (CIMH) is a training and research organization formed by integrating the Caribbean Meteorological Institute (CMI) and the Caribbean Operational Hydrological Institute (COHI). The CMI was established in 1967 by the member states of CMO and the Caribbean Operational Hydrological Institute (COHI) was established in 1982. Even though the two Institutes have been amalgamated since the mid-1980s, the organization continued to be known as the Caribbean Meteorological Institute until September 1999 when the name was officially changed to reflect the dual role of the Institute. Responsibility for the Institute's operations rests with the sixteen Commonwealth Governments of the CMO.

The role and mission of the CIMH is to improve meteorological and hydrological services and to assist in promoting awareness of their benefits for the economic well-being of the CMO countries. This is achieved through training, research and investigations, and by providing specialized services and advice.

In 1978 the Institute was designated as a Regional Meteorological Training Centre by the World Meteorological Organization (WMO) in recognition of the high standard of its training programmes. Students from all parts of the Caribbean, and sometimes beyond, are trained in such branches of meteorology as weather observing, forecasting, radar and satellite meteorology, instrument maintenance, agro meteorology, and climatology, as well as operational hydrology.

Primary functions of the CIMH are:

- Provide facilities to train various categories of meteorological and hydrological personnel
- Operate as a research centre on meteorology and hydrology and associated sciences
- Operate as contractors and consultants on various meteorological and hydrological projects
- Maintain a service for the upkeep, repair, and calibration of meteorological instruments
- Provide advice to participating governments on meteorological and hydrological matters
- Collect, analyze, and publish meteorological and hydrological data.

Source: CIMH 2007

3.3.2 The University of the West Indies

The University of the West Indies (UWI) was established in 1948 initially as an external College of the University of London and became fully independent in 1962. It is the oldest, fully regional institution of higher learning in the Commonwealth Caribbean (University of West Indies 2006).

With three campuses (i.e. Cave Hill, Barbados; Mona, Jamaica; and St Augustine, Trinidad and Tobago), and 12 centres in the other contributing countries (known as the UWI-12), the UWI currently has an enrolment totalling more than 36 000 students each year, and it graduates approximately 5 800 students at undergraduate, graduate and diploma levels.

The Climate Studies Group, at the UWI Mona Campus, conducts statistical analyses of climate, analyses of climate dynamics, and regional climate modelling using the MM5 and PRECIS models. The Group also participates in the Assessments of Impacts and Adaptations to Climate Change (AIACC) project and it is assisting with climate change scenarios in the MACC project.

UWI recently launched a Centre for Disaster Risk Reduction (pre-disaster phase) to begin coordinating a regional approach to disaster management.

The UWI at St. Augustine has signed a Memorandum of Agreement (MoA) with the CCCCC, to cooperate and undertake joint ventures on research, education, training and institutional strengthening on all aspects of climate change to benefit not only the CARICOM region but the international community at large (CARICOM Secretariat 2007). The MoA focuses specifically on research and education regarding the geophysical and socioeconomic impact of climate change on biological diversity, tropical agriculture, the rise of the sea level and coastal erosion.

3.3.3 The Caribbean Disaster Emergency Response Agency

The Caribbean Disaster Emergency Response Agency (CDERA)[15] is the CARICOM agency responsible for disaster response in each of the 16 participating states. However, CDERA has been working to create a methodical and preventative approach to disaster management programmes by assessing vulnerability (ISDR, 2007).

15 CDERA members are: Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Dominica, Grenada, Guyana, Jamaica, Montserrat, St Kitts/Nevis, Saint Lucia, St Vincent and the Grenadines, Trinidad and Tobago and Turks and Caicos Islands.

CDERA is implementing a three-year project, funded by the Canadian International Development Agency and executed by the Organization of American States, entitled the Caribbean Hazard Mitigation Capacity Building Programme (CHAMP).

CHAMP aims to help Caribbean countries to develop comprehensive national hazard vulnerability reduction policies and associated implementation programmes; it also intends to develop and implement safer building training and certification programmes. Part I of the project involves mitigation planning. Activities including:

- Increasing geographic information system and data collection resources, e.g. coastal resources inventory system, hazard assessment data and critical facilities inventories.
- Hazard mapping for such hazards as storms, coastal and beach erosion, floods, landslides, drought (as well as non-climate related hazards such as earthquakes).
- Sectorial assessments, e.g. as in the electrical utilities sector in the report entitled Hurricane Vulnerability and Risk Analysis of the VINLEC transmission and distribution system (St. Vincent).

These activities, along with other vulnerability assessments, were combined with marketing for the mitigation of hurricane impacts and for policy development.

3.3.4 The Inter-American Institute for Global Change Research

The Inter-American Institute for Global Change Research (IAI)[16] is an intergovernmental organization supported by 19 countries in the Americas dedicated to pursuing the principles of scientific excellence, international cooperation, and the open exchange of scientific information to increase understanding of global change phenomena and their socio-economic implications, and to augment the region's overall scientific capacity (Inter -American Institute for Global Change 2007a).

To function as a regional entity and to conduct research that no one nation can undertake on its own, the IAI was conceived as a network of collaborating research institutions working together to implement the Institute's Science Agenda (Table 12).

16 IAI members are: Argentina, Bolivia, Brazil, Canada, U.S., Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Panama, Paraguay, Peru, Uruguay and Venezuela.

Table 12: Research areas and current focus of the work of IAI.

Area	Focus
Understanding Climate Change and Variability in the Americas	To observe, document and predict climate change and variability in the Americas and its links to changes in natural systems and societal impacts. The goals are to understand the role of ocean-land-atmosphere interactions in climate, to determine the key processes that cause climatic variability, from seasonal to decadal time scales, and to apply the insight gained by these findings to improve weather and climate predictions.
Comparative Studies of Ecosystem, Biodiversity, Land Use and Cover, and Water Resources in the Americas	To encourage comparative and integrated analyses of the effects of Global Environmental Change on natural and anthropogenic systems and processes among tropical, temperate and cold latitude systems. Sponsored work should increase our knowledge of the drivers and dynamics of variability, and the impacts such variability has on food security, biodiversity and the provision of ecological goods and services. Research is expected to include work in terrestrial, coastal and oceanic environments; work that integrates across the land/sea interface will be encouraged. That could include impacts of global change on biodiversity, including species and genetic biodiversity, both of natural systems and agricultural systems and cultivars, and comparative studies of the resilience of ecosystems, key species, and important agricultural cultivars to global change.
Understanding Global Change Modulations of the Composition of the Atmosphere, Oceans and Fresh Waters	Observing, documenting and understanding processes that modify the chemical composition of the atmosphere, inland waters and oceans in a manner that affects productivity and human welfare. A multidisciplinary approach to this research area is expected.
Understanding the Human Dimensions and Policy Implications of Global Change, Climate Variability and Land Use	To research the dynamic interaction of global change, climate variability, land use as well as the health, welfare and activities human beings that depend on ecosystems' productivity, diversity and functioning. The emphasis of the research is on projects that address the complex interactions between natural and socio-economic systems through interdisciplinary approaches. The objective is to inform public policies that increase sustainability of natural systems and human welfare.

Source: Inter-American Institute for Global Change 2007b

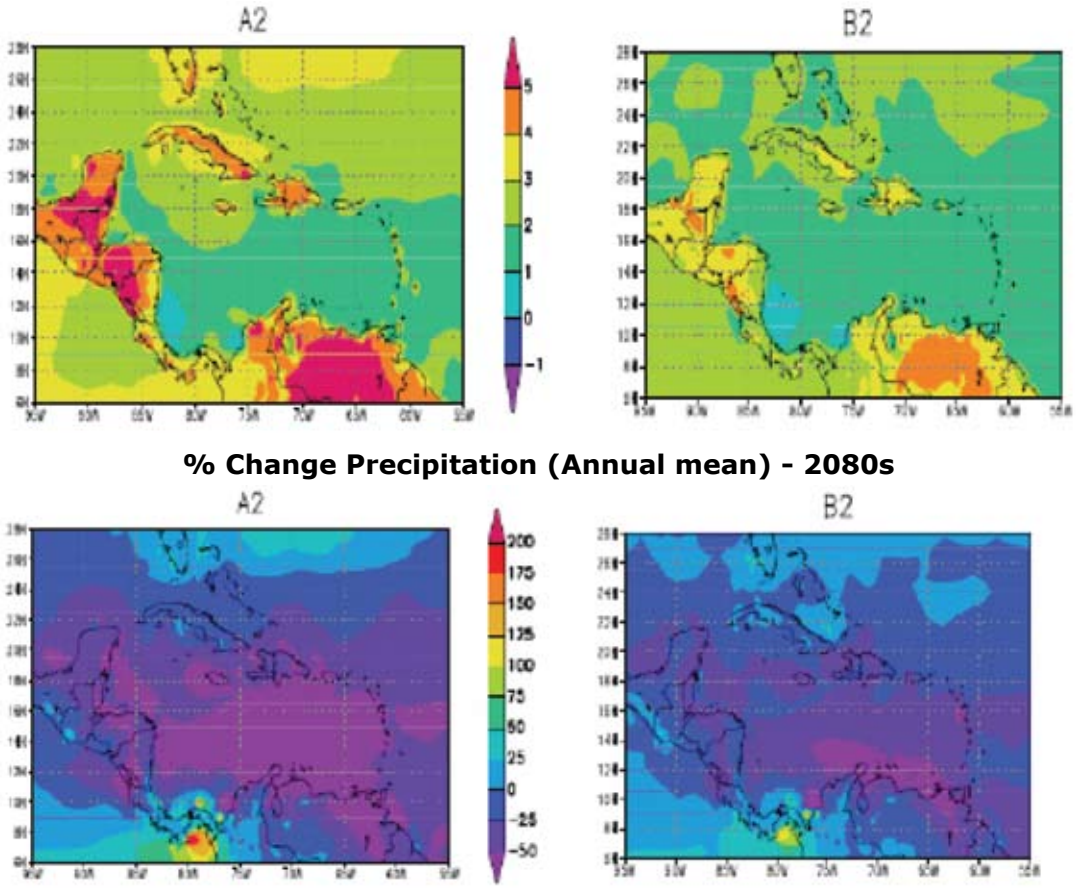
3.3.5 Developing Regional Scenarios

The PRECIS system

Providing Regional Climates for Impacts Studies, PRECIS, is a system of regional climate modelling developed by the Hadley Centre of the Meteorological Office of the United Kingdom, in order to facilitate its use for the Non-Annex 1 Countries under the UNFCCC (The Met Office Hardley Centre 2008). PRECIS is based on the assumption that the scale of existing "models" is not sufficient to address climate change in SIDS (Figure 10).

In the Caribbean Region the PRECIS project falls under the Caribbean Climate Change Project to enable climate projections of the region to be made for a 30-year period (2070-2100). PRECIS participants include Cuba, Jamaica, Barbados, Belize and the CCCCC.

Figure 10: Images generated by PRECIS



Source: INSMET and UWI 2006

Scenario generator models are also freely available, such as MAGICC (Model for the Assessment of Greenhouse-gas Induced Climate Change) and SCENGEN (A Regional Climate SCENario GENerator). MAGICC and SCENGEN are user-friendly interactive software suites that allow users to investigate future climate change and its uncertainties at both the global and regional levels. In running MAGICC/SCENGEN, the user can intervene in the design of global or regional climate change scenarios (Tompkins and others 2005).

Modeling the Vulnerability of Biodiversity to Climate Change in Mesoamerica and the Dominican Republic

Given the importance of downscaled, high-resolution climate change data to planning for climate change adaptation, the Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC) has been involved not only in the downscaling of global climate model data at the level of Mesoamerica and the Dominican Republic, but also in the interpretation of such downscaled data for the assessment of vulnerability of ecosystems and their constituent species to climate change. CATHALAC's work in this area has occurred in the context of the Regional Visualization and Monitoring System (SERVIR) which the Center is implementing with NASA, the U.S. Agency for International Development and other partners, and the GEF-supported Capacity Building for Stage II Adaptation to Climate Change in Central America, Mexico and Cuba project (Cherrington 2007).

Figure 11a: IPCC Global Climate Model outputs v.s. Downscaled Climate Change Data generated by SERVIR – Case of Belize

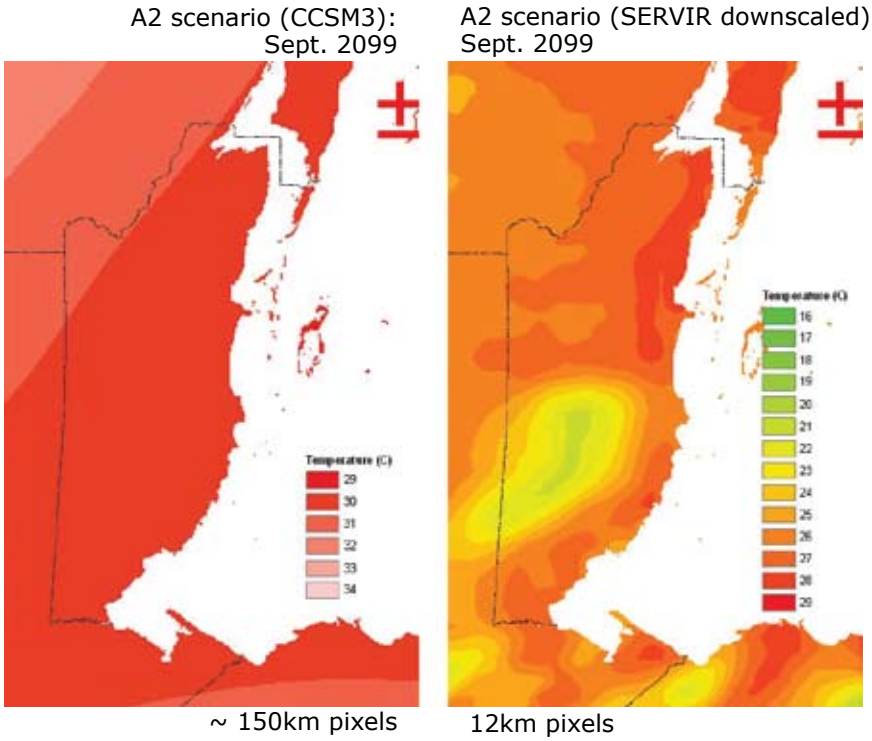
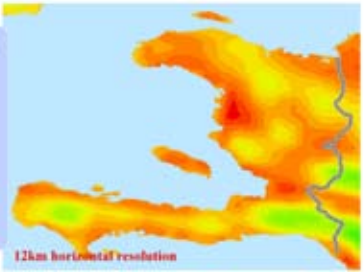


Figure 11b: IPCC Global Climate Model outputs v.s. Downscaled Climate Change Data generated by SERVIR – Case of Haiti

Sept. 2099: A2 Scenario (CCSM3)

~150km horizontal resolution

Sept. 2099: A2 Scenario (SERVIR)



12km horizontal resolution

CATHALAC and its partners were involved in the development of the highest resolution climate change scenario data for Mesoamerica, with 12km horizontal resolution outputs being produced for the sub-region covering the period 2005-2099. In exploring the possible impacts of climate change on the sub-region's biodiversity, CATHALAC has also developed a methodology for combining climate change scenario data with data on species locations and ecosystems to identify areas where biodiversity will most likely be affected by climate change. CATHALAC has completed a study modeling the sub-region's vulnerability to climate change (under the A2 scenario), and the results of such are available through SERVIR at www.servir.net (Figure 11a and 11b).

3.3.6 Insurance as a Tool for Risk Reduction and Risk Management

Since 1991 SIDS have identified insurance-related action as essential for addressing the impacts of climate change and increasingly frequent and extreme weather events in their countries. In 1991, AOSIS sought to establish an International Insurance Pool to address the direct impacts of climate change on small island states and low-lying countries. This ongoing need was highlighted again at the Expert Meeting for SIDS on Adaptation, held in Jamaica and the Cook Islands in February 2007; it is a need that still remains critical.

Insurance is a vital instrument for most SIDS, particularly for coastal communities and such sectors as tourism. Insurance-related action provides a unique opportunity to spread and transfer risk and provides incentives for risk reduction and prevention; this also fosters resilience to external shocks while engaging the private sector in climate change response action.

One of the benefits of promoting insurance-related action is that it will help to advance efforts to quantify risks and potential losses due to climate change.

Beyond its limitation, it is recognized (UNFCCC 2007b) that insurance-related action provides a unique opportunity to spread and transfer risk, and provides incentives for risk reduction and prevention and, therefore, fosters resilience to external shocks while engaging the private sector in climate change response action. One of the benefits of promoting insurance-related action is that it will help to advance efforts to quantify risks and potential losses due to climate change (Box 11).

The Caribbean is highly dependent on the reinsurance market. Due to the region's high risk exposure and losses over the years, very few indigenous insurance companies have developed significant capital bases to sustain more risk. As a result, the insurance industry is still very reliant on large international reinsurers in transferring risk (Binger and others 2007). Insurance rates continue to increase in the Caribbean from year to year, irrespective of whether the region has been affected by a disaster or not.

Box 11: The United Insurance Company Limited "Hurricane Mitigation Programme"

In 1997, the United Insurance Company of Barbados initiated its international Hurricane Mitigation Programme with a view to reducing the vulnerability of Caribbean property to hurricanes. It has done so by producing the document entitled **Guide to making your home hurricane resistant**, and by providing the financial incentives to put in place the preventative measures presented in this document.

The Hurricane-Resistant Safeguard Compliance Checklist has seven different sections: external sides, roofs, windows, doors, other apertures, solar water heaters and air conditioners, and roof shapes. Compliance with measures under the first five categories reduces the insurance premium by 17.5 per cent. Compliance with all safeguards results in a 25 per cent discount on the insurance premium.

The United Insurance Company operates in 14 Caribbean countries.

Source: UNFCCC 2007a

Current examples from which lessons may be learned include the Caribbean Catastrophe Risk Insurance Facility (CRIF), which could be extrapolated and localized to the circumstances of other regions (Box 12 and Table 13). The Nairobi work programme can also provide a valuable opportunity for furthering methodological efforts relating to insurance in the context of climate change adaptation.

Box 12: The Catastrophe Risk Insurance Facility (CRIF)

The world's first regional insurance resource, the Caribbean Catastrophe Risk Insurance Facility (CCRIF) was launched on 1st June 2007. The CCRIF provides participating Caribbean governments with immediate access to liquidity if hit by a hurricane or earthquake. The CCRIF is operated by Caribbean Risk Managers Ltd. (CaribRM), a division of the CGM Group, with support from Sagicor Insurance Managers Ltd.

A parametric solution, based on the predefined hazard and actuarial models developed for the region, has been designed to automatically respond. This means that the participating nations will immediately qualify to receive a standard cash injection based on the severity of the catastrophe.

The CCRIF's capacity to service claims is based on its own reserves, combined with the financial capacity of the international financial markets which together allow the facility to respond to events occurring once every 1,000 years or more, achieving a level of resiliency that surpasses international standards.

CCRIF participating nations are: Anguilla, Antigua and Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago, and Turks and Caicos Islands.

Source: The World Bank Group 2008b

Table 13: Some examples of Caribbean island Building Codes in 2002

Country	Building Code Status	Building Inspection Capacity
Anguilla	• Building Code completed and being used administratively • Building regulations mandatting the use of the Code will be incorporated into the new Physical Planning Ordinance	• Being developed • One inspector employed by the Department of Physical Planning
Antigua and Barbuda	• Completed • Based on CECS model building code • Legislated in 1996 as regulation under the Development Control Ordinance	• Five building inspector on staff • Training programme to be developed
Barbados	• Draft Code developed in 1993 • Technical provisions Being based on standards caontained in CUBIC • A Building Authority Being established • Appointment of Building Inspectors going ahead	• Recomentadions made for engagning an adecuate number of building inspectors for monitoring residential construction • Professional engineers and architects on a case-by-case basis will monitor other buildings
Dominica	• Code drafted, based on CECS model building code and submited for legislative review • Dominica Physical Planning Act being set up to mandate the use of the Building Code	• Development Control Authority has five building inspectors
Jamaica	• National Building Code drafted and distribuited for comment in 1984 but not adopted • Revised code in progress • Building by-laws apply in each Parish and in Kingston-St. Andrew	• Each Parish has building inspectors • Staffing in some places will have to be augmented to ensure that building plans can be properly reviewed in accordance with the new Code
Trinidad and Tobago	• Building Code drafted and submitted for comments and enabling legislation submitted for legislative approval • For engineered buildings, British, American and Canadian codes are used as standards	• Special commitee mandated to prepare building regulations for legislative review

Adapted from "Caribbean risk management guidelines for climate change adaptation dicision making" Adapting to Climate in the Caribbean Project (2003), Caribbean Community (CARICOM) Secretariat p 66.

Source: Tompkins and others 2005

3.4 International and Regional Framework for Cooperation and Capacity Building

Internationally coordinated capacity-building through the UNFCCC and appropriate regional agencies is recognized as being extremely important in advancing climate change adaptation in the region (UNFCC 2007b). To share experiences and lessons learned by communities facing similar problems, climate change ought to be mainstreamed into the work of different regional organizations and networks, in particular, though partnerships among sectors such as water, energy and agriculture.

And, as for external support and North–South cooperation, there is a critical need to ensure continuity (a programme-based rather than project-based approach) and adherence to the strategic direction for support identified by the UNFCCC COP, as well as the Mauritius Strategy.

There is still much room for improvement in regional and international cooperation, with active participation of all sub-regions. Improving coordination of different efforts being made is critical to improve effectiveness and delivery at national level. It is also important to strengthen links between different institutions, activities and processes including those among different MEAs, Intergovernmental Organizations, and United Nations agencies.

Some examples of regional and international partnership building and cooperation frameworks, and on the involvement of the Caribbean Region, are reflected in the following sections.

3.4.1 Regional Framework

The Caribbean Community and Common Market

The treaty establishing CARICOM entered into force in August 1973. However, the current version of CARICOM[17] is the latest evolutionary stage of the process of Caribbean integration that started with the establishment of the British West Indies Federation in 1958.

17 CARICOM has 15 Full Members: Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, St Lucia, St Kitts and Nevis, St Vincent and the Grenadines, Suriname, and Trinidad and Tobago; 5 Associate Members: Anguilla, Bermuda, British Virgin Islands, Cayman Islands, and the Turks and Caicos Islands; and 5 Observers: Aruba, Cuba, Dominican Republic, the Netherlands Antilles and Puerto Rico. Of the 11 non-independent Caribbean countries, only Montserrat has full membership in CARICOM.

In 2000, CARICOM, which provides an important framework for adapting to climate change, established its Centre on Climate Change (see Section 3.2.4) whose aims are: to protect the climate system in the region; enhance the capacity of member governments to coordinate national responses to climate change; provide policy and technical support on climate change issues, and act as an executing agency for regional projects relating to climate change.

The Organisation of Eastern Caribbean States

The Organisation of Eastern Caribbean States (OECS)[18] was established on 18 June 1981 when seven Eastern Caribbean countries signed a cooperation treaty to promote unity and solidarity among the members (Organisation of Eastern Caribbean States 2007).

The Organisation's Environment and Sustainable Development Unit has brought the member governments together to create the St. Georges' Declaration of Principles for Environmental Sustainability in the OECS. The Declaration contains 21 principles drafted by governments and individuals in member states as a guide to managing the environment in their countries. Of special importance is principle eight "Preparation for Climate Change" which states that: "Governments will enact laws, create organizations and institutions and provide money to assist people and communities to adapt to the impact of climate change".

The policy of the OECS regarding adaptation focuses on enhancing the resilience of a whole island under the "island systems management" framework, rather than concentrating on sectorial adaptation. It is both an integrated and holistic approach to the management of an island's socio-ecological systems including terrestrial, aquatic and atmospheric environments (Mimura and others 2007).

The Regional Seas Programmes (Caribbean Environment Programme)

The Caribbean Environment Programme (CEP) is one of the Regional Seas Programmes administered by UNEP. The CEP is managed by and for the countries of the Wider Caribbean Region through the Caribbean Action Plan (1981) that outlines regional environmental challenges (Caribbean Enviroment Programme 2008).

18 OECS has 7 Full Members: Antigua and Barbuda, Dominica, Grenada, Montserrat, St Kitts and Nevis, St Lucia, and St Vincent and the Grenadines and 2 Associate Members: Anguilla and the British Virgin Islands.

The Action Plan led to the 1983 adoption of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention), which provides the legal framework. The Convention has been supplemented by three protocols addressing specific environmental issues: oil spills, specially protected areas and wildlife; and land-based sources and activities or marine pollution. The CEP offers the programmatic framework for the Cartagena Convention.

The Caribbean Regional Co-ordinating Unit (CAR/RCU) located in Kingston, Jamaica, was created in 1986 and serves as the CEP's secretariat. The CEP has three main sub-programmes:

- Assessment and Management of Environment Pollution (AMEP).
- Specially Protected Areas and Wildlife (SPAW).
- Communication, Education, Training and Awareness (CETA).

Although none of the CEP sub-programmes specifically targets climate change, it will pose a threat to its work, and, therefore, adaptation should be a key concern.

The Association of Caribbean States

The convention establishing the Association of Caribbean States (ACS)[19] was signed on 24 July 1994 in Cartagena, Colombia, with the aim of promoting consultation, cooperation and concerted action among all the countries of the Caribbean (Association of Caribbean States 2007).

The objective of the ACS is to strengthen regional cooperation and integration among its members in order to: improve economic capacity; preserve environmental integrity, and promote sustainable development.

In ACS, the special committees on sustainable tourism and natural disasters deal with matters relating to climate change.

As a result of regional programmes that have been creating focal points within countries, and financial support received from different sources, particularly the GEF, a variety of regional support networks (see Table 14) that could be of use to climate change adaptation, have been created in the region (Thompkins and others 2005).

19 ACS has 25 Full Members: Antigua and Barbuda, Bahamas, Barbados, Belize, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Suriname, Trinidad and Tobago, and Venezuela; 3 Associate Members: Aruba, France (on behalf of French Guiana, Guadeloupe and Martinique) and the Netherlands Antilles.

Table 14: Regional support networks in the Caribbean		
Scale	Focus	Association/Linkage
	Coastal health	Caribbean Coastal and Marine Productivity Programme
	Emergency assistance	Other Caribbean Islands, assisting in an emergency (informal morally-based links)
	Financial planning	Caribbean Development Bank
	Health management	Caribbean Epidemiology Centre (CAREC) Caribbean Health Research Council Caribbean Environment and Health Institute
	Water Management	Caribbean Water and Waste Water Association
	Climate Observation	Global Climate Observing System
	Emergency assistance	UK emergency and humanitarian assistance to its Overseas Territories
	Health management	World Health Organization/Pan American Health Organisation
Source: Thompkins and others 2005		

3.4.2 International framework

The Small Island Developing States Network

The Small Island Developing States Network (SIDSnet) is a direct follow-up to the 1994 BPoA. SIDSnet connects 43 island nations of the Pacific, the Caribbean, the Atlantic, the Indian, the Mediterranean and the African seas. SIDSnet's main goal has been to utilize information and communication technologies (ICTs) to link SIDS to support the implementation of the sustainable development objectives of the BPoA.

The project was launched in 1998 through UNDP's Sustainable Development Networking Programme (SDNP) and the AOSIS. The Water Resources Management and Small Island Developing States Branch of UNDESA currently administer the project (UN Division on Sustainable Development 2007).

Through its web site it provides tools for virtual discussion forums, chat conferences, focused searching, document submission and storage, mailing lists, events calendar, and links to relevant BPoA web sites. Six particular themes have been identified - sustainable tourism, coastal and marine resources, biodiversity, climate change, energy, and trade. SIDSnet also mirrors several websites, and offers general information and links on Caribbean countries.

The Forum of Ministers of the Environment of Latin America and the Caribbean

The Forum of Ministers of the Environment of Latin America and the Caribbean (Forum of Ministers) was created in 1982. It is the region's longest standing, most representative – all 33 LAC countries are members - political gathering for reaching agreement on environmental policies and responses. The Regional Office for Latin America and the Caribbean of the United Nations Environment Programme (UNEP/ROLAC) acts as its Secretariat. Since its establishment, the Forum of Ministers has held 15 meetings in the region, providing guides to environmental action targeting the priorities that identified by ministers and promoting more efficient and coherent regional and international cooperation. Four meetings of the Forum of the Ministers have taken so far place in the Caribbean: Trinidad and Tobago in 1990, Cuba in 1995, Barbados in 2000, and Dominican Republic (2008).

Climate Change is one of the priority areas on which the Forum is taking action. The last Ministerial Meeting (Dominican Republic 2008) decided to internalize the outcomes of the Thirteenth Conference of the Parties to the United Nations Framework Convention on Climate Change and the Third Meeting of the Parties to the Kyoto Protocol, held in Bali in December 2007, in particular its Bali Action Plan, and to integrate measures into development policies, taking into account the social, economic and environmental vulnerability of the Region, particularly of the low-lying coastal and Small Island Developing States with regard to the effects of climate change and to adapt to these effects.

The Decision also recognized the progress made by Latin America and the Caribbean in the submission of projects under the Clean Development Mechanism and encourage the exchange of experiences, tools and methodologies among countries in the Region and work with the Executive Board of the Clean Development Mechanism and the Convention for a better regional distribution of these projects, particularly in small island developing countries in the Region.

Finally the Decision encourage and support regional, subregional and national initiatives to conduct vulnerability assessments, improve data collection and implement measures of adaptation, as well as promoting dialogue on issues

of common interest relating to the international negotiations, while promoting synergies among these initiatives at the regional level, and to promote education, public sensibilization and capacity building in relation to prevention and reduction of vulnerability, mitigation, and adaptation to climate change in the Region, as well as to share information and meaningful experiences to facilitate the transfer of knowledge and the establishment of synergetic alliances among civil society and the governments.

A working Group on Climate Change was created in 2003 to promote and coordinate the work undertaken in this area[20].

The Global Climate Observing System

The Global Climate Observing System (GCOS) was established in 1992 to ensure the observations and information needed to address climate-related issues are obtained and made available to all potential users. It is co-sponsored by the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission of UNESCO, UNEP and the International Council for Science. In the Caribbean, the CPACC project has also played an important role in establishing an observation system to enable GCOS to expand into the Caribbean (GCOS Secretariat 2008).

The GCOS Regional Action Plan for Central America and the Caribbean is not very advanced, although many its elements have been implemented or are currently being addressed, including upgrades of tide gauges (through the MACC project) and of the GCOS Upper Air Network (GUAN) and GCOS Surface Network (GSN) networks; data rescue; replacement of the telecommunications systems, and establishing a Regional Technical Support team. Surface and groundwater monitoring networks are being assessed and regional data warehousing is being created.

Assessments of Impacts and Adaptations to Climate Change project

The GEF enabling project Assessments of Impacts and Adaptations to Climate Change (AIACC), was launched in 2001 by the Global Change SysTem for Analysis, Research and Training (START), the Third World Academy of Sciences (TWAS), UNEP, and IPCC. The project is funded through the GEF, with participation of developing countries, the US Agency for International Development, the US Environmental Protection Agency, the Canadian International Development Agency, and the Rockefeller Foundation. AIACC seeks to:

20 The Working Group is currently being coordinated by Panama. Other members in LAC are Trinidad and Tobago, Belize, St. Lucia, Suriname, Antigua and Barbuda, Jamaica, Haiti, Guyana, Granada, Mexico, Cuba, Costa Rica, Peru, Chile, El Salvador and Ecuador. It receives support from the IDB, the World Bank, ECLAC, UNDP, and UNEP.

- Advance scientific understanding of climate change impacts, vulnerabilities and adaptation options in the developing world.
- Build scientific and technical capacity to support National Communications to the UNFCCC and enhance participation by developing country experts in IPCC and other international science activities.
- Develop networks that link science and policy communities to support adaptation planning and action.

The AIACC regional assessments were begun in early 2002. Projects involving the Caribbean Region have been developed (Box 13).

Box 13: Climate Variability Impacts on Dengue and Vulnerability in the Caribbean (AIACC Project No. SIS06)

The occurrence of dengue fever in relation to climate variability in the Caribbean was studied for the period 1980-2002. All the Caribbean Epidemiology Centre Member Countries (CMCs) where the disease was prevalent were included in the study.

Results show that incidences of dengue were higher in the past decade than in the previous one. The annual patterns of reported cases were almost periodic and compared closely with the periodicity of ENSO events. More dengue outbreaks seemed to occur in El Niño and El Niño + 1 year.

A comparison of the annual pattern of variation in dengue cases with the variations in precipitation and temperature signalled that warmer temperatures and less rainfall appear to be influencing the epidemics.

Source: GEF AIACC 2004

Chapter IV

Time for Concrete and Concerted Action

Caribbean SIDS now experiences the impacts of human-induced climate change. Time is running out and there is an urgent need to translate ideas into concrete action.

In Bali, December 2007, AOSIS remarked that climate change is the critical issue that confronts each and every one of the 44 members estates as SIDS endeavour to advance on a sustainable basis while preserving the core cultural values and unique island identity.

For SIDS, the goal of stabilizing temperatures at 2 degrees above pre industrial levels, fails to consider the survival of island states, and means the lose of many critical ecosystem, including coral reef and fisheries, the flood of coastal communities, stronger storms, reduced water supply, increased droughts and desertification and threaten to food security.

Consequently AOSIS claimed that the avoidance of adverse impacts on SIDS should be the fundamental benchmark against which all the negotiation of the Bali Roadmap be conducted.

4.1 Advancing development goals in a sustainable manner

Development is challenged by the most serious consequences of climate change. To face that challenge, mitigation and adaptation measures should be immediately included in development strategies, programmes and action.

It is essential to have environmental security and energy security if developing countries are to reach their development goals. To reduce emissions while facilitating energy independence and sustainable development, much more use should be made of renewable energy and energy efficient technologies.

A changing climate means that the process of adaptation is critical for the Caribbean. Only by implementing adaptation options and policies will the region's vulnerability be minimized. That said, climate change mitigation activities could facilitate sustainable development pathways and produce multiple co-benefits, including: air pollution abatement; balance of trade improvement; providing rural areas with modern energy services; avoiding environmental threats caused by fossil fuel pollution; and more jobs. Moreover, as most Caribbean SIDS depend on expensive imported fossil fuels, savings accrued from renewable energy and energy efficiency measures may allow scarce resources to be channelled to adaptation activities.

Non-Annex 1 Parties to which Caribbean Countries belong, have reported a number of measures to combat climate change in their national communications (Box 14).

Box 14: Measures to combat climate change in non-Annex I countries

Non- Annex Parties have reported the following measures that combat climate change in their national communications:

Energy supply:
- Improving energy efficiency and conservation;
- increasing transformation eficiency;
- modernizing their electric utilities;
- reducing losses in transmission and distribution;
- developing plans to promote rural electrification and use of renewable energy sources.

Energy demand:
- Promoting information in the transport, residential, commercial and industrial subsectors.

Agriculture:
- reducing methane emissions in rice cultivation improved farm management practices;
- changing tradirional farm practices;
- reducing areas under cultivation;
- shifting to shorter-durationrice varieties;
- rotating crops;
- diversifying and intensifying crops
- increasing areas under directly seeded rice;
- providing training and dissemination of information on mitigating methane emissions from rice paddles;
- improving water management through soil aeration and periodic drainage of paddy fields;
- adopting intermittent irrigation systems;
- using chemical compounds to inhibit the producction of methane;
- improving cattle management practices;
- optimizing livestock populations;
- improving livestock production through diet;
- using nutrient supplement urea - molasses mineral block;
- suplementing poor quality roughage with legumes and/or low cost agricultural by products;
- expanding pasture and forage conservation for dry-season feeding;
- improving collection,use and storage of organic waste;
- using animal waste for energy production

Land-use change and forestry:
- conserving existing forest cover;
- developing commercial plantations, agroforestry
- preventing and controling forest fires;
- controling diseases and pests;
- controling acid rain damage;
- creating woodland, low-impact logging;
- improving timber utilization;
- converting low productivity lands into grasslands rangelands.

Waste management:
- minimizing waste at the production, distribution, consumtion and disposal stages;
- recycling waste;
- improving organic waste collection, utilization and storage systems;
- improving waste-water treatment;
- using waste for energy production;
- incinerating waste;
- regulating to control urban industrial pollution.

Source: UNFCCC 2006b

While Caribbean countries must insist on the commitment of Annex 1 Parties to take significant action to reduce GHG emissions, they should take advantage of the Kyoto Protocol and the emerging carbon market to move towards a more efficient, reliable and economically competitive, less carbon intensive, energy sector.

Becoming more aware of the synergies between work on mitigation, carbon revenues, and adaptation opportunities, the Caribbean SIDS are seeking ways to become less vulnerable while staying on the sustainable development track.

Adaptation to climate change should not be viewed as a series of activities or a process in isolation; instead, it should be integrated into the entire developmental process, so that short-term measures can have long-term benefits, thus maximizing the returns on overall adaptation expenditure.

4.2 Developing vulnerability and adaptation assessments

There is a need to ensure that models, tools and methodologies are available that are appropriate for making assessments in SIDS, as well as the training and technical support needed to be able to use them.

Vulnerability and adaptation (V&A) assessments are vital tools to help Caribbean SIDS to evaluate and implement responses to climate change. Although insufficient, several options are available in the region to improve techniques to make assessments and then to successfully apply them.

Efforts to improve and reduce the cost of adaptation assessments for both autonomous and planned adaptation are also vital. Such efforts to enhance assessments and related methodologies should try to be consistent with the work undertaken within the framework of the Nairobi Work Programme.

In this respect, several measures could be considered such as to: adopt special mechanisms for V&A training (e.g. establishing a group of experts to help make assessments appropriate for the specific circumstances of SIDS); request the IPCC to prepare a special report on SIDS; fully engage the private sector from the North and South in sectorial adaptation planning and implementation; promote interregional and intraregional cooperation on modelling; make an economic evaluation of adaptation; and quantify adaptation costs.

Socio-economic information needs to be better integrated into V&A assessments. This includes linking climate vulnerability to socio-economic studies, long-term periodic and socio-economic assessments, studies on coping strategies, and gender specific vulnerability assessment. Top-down (scenario-based) and bottom-up (based on analysis of current vulnerability) approaches as well as consideration of community-based participatory approaches, need to be complementary.

The decision making process, including pursuing policies to include in national development planning the assessment of V&A to climate change, requires effective application of tools and scientific input.

Sustainable high-quality and long-term observational monitoring of climate, agro-climate, and sea level is vital for Caribbean SIDS. Improved rescue and data inventories are needed, and better use should be made of geospatial information to increase data access as well as to integrate high-resolution downscaling models.

It is equally important to bridge the gap between assessing, planning and implementing adaptation as well as community needs and national and sectorial planning; one way of doing this is by merging top-down and bottom-up policy decisions and approaches to planning. Support projects need to be matched to priority needs, including more funding and projects for community-based adaptation, as well as addressing the role and application of traditional knowledge. In addition, mechanisms must be introduced to validate adaptation options.

4.3 Addressing actions on adaptation

While recognizing that adaptation to climate change is already taking place in the Caribbean Region - as reflected in this report - it is happening on a limited basis, and in many cases adaptation measures are being taken in isolation instead of as a result of integrated strategies.

Although many adaptation measures can be implemented at low cost, comprehensive estimates on adaptation costs and benefits are currently lacking. Furthermore, adaptive capacity is uneven across and within countries.

To remedy this situation, institutional development and technical assistance to respond to climate change must be strengthened, and the Caribbean SIDS must continue to focus on improving knowledge about regional climate trends and their projected impacts.

A priority for Caribbean SIDS is to implement practical adaptation measures at all levels – from community to national. There is a need to develop integrated, well planned and coordinated adaptation action and adaptation projects, and to improve funding for adaptation-related activities through existing and new international official development assistance and private sector mechanisms.

Many short-term adaptation activities in the Caribbean may be very easy to implement. These may include: adjusting and implementing building codes; restricting construction in areas susceptible to coastal flooding; or changing

crop varieties according to long-term weather forecasts (table 15): It is critical, however, for the Caribbean to avoid investing in ineffective measures, such as rebuilding in areas known to be particularly susceptible to extreme events - a recurring characteristic of the Caribbean.

Long-term solutions to address climate change issues must begin with a sound regulatory framework that establishes minimum performance standards. This approach has to include an incentive system that sends the right signals to individuals. Building in highly hazardous areas must be totally discouraged both by regulations and by appropriate risk bearing. People who build on flood plains, on steep slopes, or along erosive shorelines should be discouraged from doing so.

Table 15: Some indicative adaptation options for the Caribbean

Sea Level Rise	• Build seawalls and breakwaters • Enhance preservation of natural sea-defences (mangroves) • Relieve anthropogenic stresses on reef systems • Beach nourishment (expensive) • Prohibit sand mining • Adjust setbacks and enforce • Institute a local system of marine protected areas
Water Sector	• Desalination • Water conservation • Recycling industrial grey water • Water harvesting • Low flush toilets • Aquifer recharge • Drip irrigation in agriculture
Built-up Environment	• Buildings designed for efficient cooling • Adequate distance from eroding coasts • Locating coastal infrastructure away from eroding coasts • Facilities designed for future climate (revisit CUBIC) • Incentives (fiscal, insurance) to industry for compliance • Factor increased insurance costs into resort profitability
Enabling Government Policy	• Fiscal incentives for changes to built tourism infrastructure (e.g. retrofitting to comply with adjusted building codes) • Fiscal regime to encourage sustainable construction in less vulnerable coastal zones • Greater public infrastructure for new tourism developments e.g. coastal defence • Land use planning to incorporate CC considerations • Retraining of displaced worker

Source: Trotz 2007

Policy and development planners require effective tools to develop, disseminate and build adaptation capacity, for example through building on existing planning frameworks produced by ECLAC, OECS, and CCCCC. More effort should be made to make known the availability of these tools.

Also, awareness about adaptation needs should be raised among critical sectors and the mass media, by using current events, such as economic, weather and health crises, to promote adaptation measures with co-benefits.

4.4 Financing adaptation

Adaptation, even by means of no regrets action, will be expensive and will require considerable funding well beyond what is now available to Caribbean SIDS.

Under Article 4.3 of UNFCCC, Annex I Parties have consented to provide the financial resources needed by non-Annex I Parties to meet the agreed full incremental costs of implementing measures under Article 4.1 of the Convention. Article 4.1 measures include formulating and implementing national programmes that include measures to facilitate adequate adaptation to climate change. Under Article 4.4 developed country Parties further agreed to assist developing countries that are particularly vulnerable to the impacts of climate change to meet the costs of adapting to adverse climate effects.

Nevertheless, well over a decade after the Convention entered into force, adequate adaptation funding to implement projects has not been forthcoming as predicted and as required by the Convention. Adaptation funding through the Convention's financial mechanism remains extremely limited, and procedures for accessing these limited funds are excessively complicated.

More funds might come from increased contributions to the GEF, the Special Climate Change Fund (SCCF), and the Least Developed Countries Fund (LDCF), and from international financial institutions and multilateral organizations.

The GEF was designated as an operating entity of the Convention's financial mechanism on an ongoing basis, subject to review every four years. The financial mechanism is accountable to the COP which decides on its climate change policies, programme priorities and eligibility criteria for funding, based on advice from the Subsidiary Body for Implementation.

The proposed programming for GEF 4 (2006−2010) climate change activities is US$990 million most of which will be spent on mitigation activities. The balance will be allocated to the remainder of the strategic adaptation priority (Piloting an Operational Approach to Adaptation or SPA), the Small Grant Programme, cross-cutting capacity-building activities and support to LDCs and SIDS. A revised climate change strategy and climate change programming framework is being discussed currently by the GEF Council (UNFCCC 2007c).

Additional resources are required in SIDS Universities to train and improve the capacity to make integrated vulnerability assessments, including integrated hazard assessments and special courses, as well as to fund special regional teams to provide sustainable support to countries for their vulnerability and adaptation assessments.

4.5 Integrating action on climate change and disaster management

Climate change and disaster management must be integrated in risk management activities in the region. This includes using structured planning frameworks, strengthening the links between institutions at national and community levels to be better prepared for climate-related disasters and to build on existing mechanisms including early warning systems. In addition, a long-term outlook must be included to inform risk assessment, and to enable consideration to be given to the frequency of extreme events and worst-case scenarios.

Caribbean SIDS must have a better understanding of current climate vulnerability and of how to manage risk (e.g. by developing and implementing early warning systems). Increased collaboration between the climate change and disaster risk reduction community on applying and exchanging methods and tools can help, as can more public awareness through education. New technologies and strategies should be used; building codes and standards need to be improved so that key sectors and areas such as the agriculture sector, water, health, infrastructure and biodiversity are included. Region-specific scientific information must be used to inform risk management options.

An integrated approach to vulnerability reduction should be developed and implemented in key sectors, particularly agriculture, tourism and fisheries, to apply sustainable development planning, including local and national physical planning, tools such as geographic information systems (GIS) should be used. There should also be increased use of risk reduction financial instruments and incentives.

4.6 Adopting insurance-related action

There should be an international insurance mechanism to help SIDS manage climate risk and build risk resilient economies for which an internationally-sourced pool of funds is needed. Collective loss sharing mechanisms and international solidarity funds could address high impact extreme events that are beyond the scope of even subsidized insurance mechanisms. An international insurance mechanism can use internationally-agreed triggers for payments to countries and communities, based on wind speed, flood levels, a drought index, and sea level rise.

The establishment of the Caribbean Catastrophe Risk Insurance Facility is a promising initiative and one that could be expanded and extended to all SIDS regions.

A well-coordinated dialogue between the private sector and representatives of Parties would be useful when assessing cooperative action to be taken to increase insurance coverage for the populations affected by climate change. Because many loans could be at risk because of the absence of climate-proofing in projects, the banking sector must be involved in climate change insurance and mainstreaming adaptation.

There is a need for innovative risk transfer mechanisms to assess what market driven insurance is unable to do and to ask the international community to support the new insurance mechanisms under the Convention.

The Convention could support the consideration of cost-effective insurance initiatives tailored to the unique circumstances of SIDS, such as multi-state risk pooling mechanisms; regional reinsurance facilities; catastrophe funds linked to international financial markets; national/regional disaster funds supported financially by the international community; microinsurance; and private–public partnerships.

The use of insurance could go beyond the traditional model, for example: by using innovative mechanisms such as enabling SIDS to generate carbon credits in exchange for insurance support; through weather derivatives which provide payouts in response to weather triggers (such as a threshold wind speed as an index) rather than in response to demonstrated losses; or through a funding arrangement similar to the International Insurance Pool proposed by the Alliance of Small Island States.

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