

National Oceanic and Atmospheric Administration Caribbean Strategy

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Acronyms

ACP	African, Caribbean and Pacific (States)
CARSEA	Caribbean Sea Ecosystem Assessment
CO ₂	Carbon Dioxide
CariCOOS	Caribbean Coastal Ocean Observing System
CCCCC	Caribbean Community Climate Change Centre
CARICOM	Caribbean Community and Common Market
CaMPAM	Caribbean Marine Protected Area Management Network and Forum
CaRA	Caribbean Regional Association for Coastal Ocean Observing
CITES	Convention on International Trade in Endangered Species
CLIVAR	Climate Variability and Predictability program
CRCP	Coral Reef Conservation Program
CRW	Coral Reef Watch
CariCOF	Caribbean Regional Climate Outlook Forum
ERMA	Environmental Response Management Application
GCOS	Global Climate Observing System
GOOS	Global Ocean Observing System
ICCAT	International Commission for the Conservation of Atlantic Tunas
ICON	Integrated Coral Observing Network
ICRI	International Coral Reef Initiative
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	IOC Sub-commission for the Caribbean and Adjacent Regions
IRAP	International Research and Applications Project
U.S. IOOS	U.S. Integrated Ocean Observing System
IUCN	International Union for the Conservation of Nature
LBSP	Land-Based Sources of pollution
LMR	Living Marine Resources
MPA	Marine Protected Area
MOCHA	Meridional Overturning Circulation Heat-flux Array
NESDIS	National Environmental Satellite, Data and Information Service (NOAA line office)
NERR	National Estuarine Research Reserve
NMFS	National Marine Fisheries Service (NOAA line office)
NOS	National Ocean Service (NOAA line office)
NWS	National Weather Service (NOAA line office)
NGSP	Next-Generation Strategic Plan
NOAA	National Oceanic and Atmospheric Administration
NOC	National Ocean Council
NOP	National Ocean Policy
OAR	Office of Oceanic and Atmospheric Research (NOAA line office)
OSPESCA	Organización Sector Pesquero y Acuicola del Istmo Centroamericano (Organization of the Fisheries and Aquaculture Sector in Central America)
PPI	Office of Policy, Planning and Integration (NOAA line office)
RCOF	Caribbean Regional Climate Outlook Forum
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	U.S. Agency for International Development
WMO	World Meteorological Organization

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Introduction

Purpose and Desired Outcomes

The United States is one of several Caribbean nations and, as such, has a vested interest in working internally, and with its partners in the region, to ensure a healthy ecosystem that is well understood and that supports the safety and livelihoods of its inhabitants.

The Caribbean Strategy is the strategic approach of the National Oceanic and Atmospheric Administration (NOAA) to coordinate and integrate the capabilities of all NOAA staff and line offices¹ to address regional issues and improve the effectiveness of its mission and international cooperation in the Caribbean region (see “Scope” section for definition of region). This strategy supports NOAA’s Next Generation Strategic Plan (NGSP), the National Ocean Policy, and the president’s Climate Action Plan, addressing many high-priority objectives, but with a focus on the Caribbean region.

NOAA’s mission and breadth of expertise—its range of information resources and experience—align closely with identified needs in the Caribbean and are critical for regional sustainability: maintaining ocean, coastal, and fishery resources; forecasting and adapting to coastal, weather, and water hazards; predicting and preparing for the impacts of climate change; and understanding and observing the ocean and atmosphere. NOAA is able to both contribute to, and benefit from, a sustained and coordinated presence in the region. Support for NOAA’s efforts in the Caribbean is essential to achieve NOAA’s and the president’s domestic and international goals, and is enhanced and enabled through the cooperation and assistance we receive from our partners in the region.

A principal motive for this strategy is to better align NOAA’s engagement and leadership in the Caribbean. NOAA has many faces in the Caribbean (i.e., fisheries management, hurricane forecasting, tsunami warning, climate prediction and adaptation, coastal and marine protected area management, habitat conservation, mapping and monitoring of marine ecosystems), so it is important that the organization’s presence be well integrated and coordinated internally, as well as with our constituents and partners. Promoting a unified and integrated approach helps ensure

Vision

A vibrant and healthy Caribbean community working together to improve our understanding of, maintain, and protect ocean and coastal ecosystems and resources, adapt to a changing climate, and mitigate coastal hazards for the protection of life, property, and the livelihoods of inhabitants.

¹ See identification of NOAA Line Offices contained in the list of acronyms.

that time and resources are most effectively utilized to support domestic and international goals. For example, programs can be more mutually supportive, such as coordinating fishery management objectives with the site selection of marine protected areas. NOAA expertise, services, and products can be shared through training partnerships with Caribbean-based entities to support interagency cooperation and development of a wide base of technical and management knowledge in the region.

Each NOAA line office is engaged in domestic and international partnerships in the Caribbean. NOAA recognizes that stronger participation of Caribbean countries will extend benefits to both U.S. and Caribbean interests and that a comprehensive strategy is beneficial for addressing the multifaceted issues within the region. The Caribbean Strategy will better coordinate NOAA's work to leverage NOAA and partner resources and enhance leadership and collaboration regionally. Through implementation of this strategy, NOAA will work to ensure that

- Communication and collaboration within NOAA and with partners in the region is improved;
- NOAA mission efforts in the Caribbean region are focused on key issues to support the safety and well-being of people and resources, coordinated internally and externally, and leveraged for better impact;
- NOAA domestic and international leadership is organized, effective, and collaborative; and
- Awareness of, and support for, NOAA efforts in the region is increased.

NOAA will seek to prioritize objectives and actions, recognizing resource constraints, and will adjust the strategy as necessary to address changing needs in the region.

Scope

The ecological, socioeconomic, and geopolitical scope of the Caribbean Strategy is based generally on the Caribbean Sea Large Marine Ecosystem,² which includes U.S. and non-U.S. jurisdictions, and from this point forward will be referred to as the Caribbean or Caribbean region (see Figure 1).

This approach recognizes that ecological, oceanographic, meteorological, socioeconomic, and geopolitical patterns and processes connect people and their



Figure 1: Caribbean Large Marine Ecosystem Project Map (see footnote 2 for reference).

² The scope is generally based on the Caribbean Large Marine Ecosystem Project: <http://clmeproject.org/geosclme.html>.

environment across the Caribbean. Given the significant socioeconomic and geopolitical diversity and needs of the region, there is ample room for partnership. For example, collecting and sharing data that would otherwise be unaffordable to some, while seeking opportunities to partner with others to improve their capacity to manage resources, would benefit broader regional ecosystem health.

While embracing the Caribbean Large Marine Ecosystem boundary for the Caribbean Strategy conveys the intent to focus within the Caribbean region, it is recognized that ecological, political, and other factors from outside the region interact with this area. In particular, some descriptions of the *wider* Caribbean include the Gulf of Mexico.

The significance of ecological connectivity across this wider region was abundantly emphasized during the BP *Deepwater Horizon* tragedy of 2010 through the influence of the Caribbean Current and the Loop Current in the region. In addition, the Florida Keys National Marine Sanctuary lies at the crossroads between the Gulf of Mexico and the Caribbean Sea, has both tropical and subtropical characteristics, and is among the most biologically diverse coral reef ecosystems within the wider Caribbean.

As the Caribbean Strategy guides the prioritization and execution of efforts, it will be important to recognize and consider these connections, both in terms of their broad interdependencies and as the opportunities to more comprehensively address regional-scale environmental and socioeconomic issues.

The Challenge

The diverse cultures and economies of the Caribbean rely on healthy and productive coastal and marine ecosystems for food security, income, protection from hazards, recreation and tourism, and other vital services. Services provided by Caribbean reef ecosystems are valued at over \$4 billion per year alone as of 2004,³ with fishing and tourism playing a dominant role. About 40 million tourists visit the region annually.⁴ Fisheries provide



³ Burke, L., and Maidens, J. 2004. Reefs at risk in the Caribbean. World Resources Institute. 80 pp. http://pdf.wri.org/reefs_caribbean_full.pdf, pg. 58

⁴ Caribbean Tourism Organization, 2010 Statistics (includes Stop-over and Cruise Passengers), www.onecaribbean.org/content/files/June8Lattab10.pdf, downloaded August 19, 2011. These statistics do not include the Caribbean coasts of South and Central America.

employment and livelihood opportunities for approximately 182,000 persons in the Caribbean portion of the ACP (African, Caribbean, and Pacific) States, most of whom are considered socioeconomically disadvantaged.⁵

The people and economies of Caribbean countries are vulnerable to natural and anthropogenic stressors, such as climate change and changes in sea level, extreme weather and geologic events, and rapid growth and development. Impacts of these stressors may include congested ports, degraded and polluted watersheds and nearshore waters, unsustainable fishing practices, and loss of human life, property, and livelihoods.

Poorly regulated development and land alteration in watersheds and coastal areas, including estuaries, destabilizes shorelines and beaches, resulting in reduced shoreline protection from waves, storm surge, and tsunamis. Certain practices also reduce the vitality of nearshore habitats, such as mangroves and sea grasses. Over 75 percent of Caribbean coral reefs are threatened by human activities (with overfishing rated as the most pervasive threat), and it is estimated that continued decline could cost the region, by 2050, between \$350 million and \$870 million per year in lost revenue across the fisheries and tourism sectors, combined with the net value of lost benefits from reef-associated shoreline protection.⁶

Coastal communities, on through to the level of commonwealth and territorial authorities, rely on a wide range of economic and social services provided by coastal and marine ecosystems, and they benefit from accurate and timely environmental information to inform decision-making for human protection, security, and effective stewardship. Communities that manage these services for long-term benefit through sound economic and social practices are typically more sustainable and resilient.

Decision-making in the Caribbean is complex, given that many nations, with the support of international organizations, manage the Caribbean Sea. Therefore, the region must rely on cooperation among all neighbors to successfully protect lives and property and sustainably manage resources.

NOAA's Role

The Caribbean region is highly relevant to the environmental and other security interests of the United States, and NOAA's skills and those of international scientists, managers, and decision makers are relied on to protect lives, livelihoods, and property. NOAA is already engaged in these issues with domestic and international stakeholders throughout the Caribbean.

⁵ Haughton, M.O. Circa 2005. Fisheries subsidy and the role of regional fisheries management organizations: The Caribbean experience. www.unep.ch/etu/Fisheries%20Meeting/submittedPapers/MiltonHaughton.pdf

⁶ Burke, L., Maidens, J., Spalding, M., Kramer, P., Green, E., Greenhalgh, S., Nobles, H. and Kool, J., 2004. Reefs at Risk in the Caribbean. World Resources Institute, Washington, D.C.

This foundation of cooperation can be utilized to build partnerships around common concerns and most effectively focus regional assets and capabilities on high-priority environmental and socioeconomic issues (reference *NOAA Inventory of Caribbean Region Programs and Projects*).⁷

Even in this austere fiscal environment, this strategy bolsters NOAA's ability to focus initial efforts on the most critical needs, while leveraging or supplementing ongoing efforts. This strategy creates a framework for working with partners and communities to develop stronger capacities and attract additional resources for addressing longer-term challenges.

Cross-Cutting Principles

Implementation of the strategy's goals and objectives will be facilitated by embracing certain principles. These principles are based on surveys and needs assessments of Caribbean stakeholders,⁸ the National Ocean Policy priority objectives, and NOAA's working experience in the Caribbean. NOAA will apply the following principles in the planning and execution of this strategy:

Enhance Partnerships for Effective Regional Ocean Governance

The Caribbean region is a mosaic of over 40 countries and territories, creating geopolitically complex governance structures. Agencies and groups may desire to work together but often encounter obstacles with existing structures. NOAA will work with partners and stakeholders to identify and, if possible, surmount those structural and organizational challenges, facilitating improved governance, optimization of resources and partner financial mechanisms, and collaboration at all levels. NOAA will strive foremost to collaborate with established regional entities that represent the numerous stakeholders and countries in the region.

Cross-Cutting Principles

- *Enhance Partnerships for Effective Regional Ocean Governance*
- *Enhance Communication, Coordination, and Exchange of Information*
- *Build Capacity*
- *Strengthen Science, Data Stewardship, and Applications*
- *Respect Diverse Cultures and History*
- *Achieve Greater Continuity*

⁷ *NOAA Inventory of Caribbean Region Programs and Projects*. Created by an internal NOAA working group to support the development of the Caribbean Strategy. Informal working product, non-exhaustive, date stamped. Available upon request: email jeff.payne@noaa.gov.

⁸ *Synthesis of Existing Needs Assessments for the Caribbean Large Marine Ecosystem*. Informal working product, non-exhaustive, 51 sources. Created by an internal NOAA working group to support the development of the Caribbean Strategy. Available upon request: email jeff.payne@noaa.gov.

Enhance Communication, Coordination, and Exchange of Information

Consistent and effective communication and coordination among international, national, and local bodies, including agencies working on compatible missions, can facilitate research, management, operations, and access to resources in the region. Needs assessments specifically underscore the importance of communicating scientific information in non-technical terms to broaden outreach and encourage the cooperation of resource user groups, conservation interests, and decision makers. NOAA efforts in the region should support and utilize communication and coordination at multiple levels, including building public awareness of the significance and value of marine and coastal resources, the challenges of a changing environment, including episodic and chronic hazards, and NOAA's work in the region. Better communication and coordination promotes trust and participation in science-driven management, enhances community education, and results in more effective implementation of activities and realization of outcomes.

To further this principle, a steering committee composed of both NOAA employees and partners has been established to guide a NOAA in the Caribbean (NOAACarib) regional collaboration initiative.⁹ The goal of NOAACarib is to identify and respond to local and regional challenges, needs, and opportunities in the Caribbean region through collaboration across NOAA and with partners. NOAACarib is achieving this goal by

1. Improving coordination and application of NOAA capabilities through enhancing internal NOAA communications on Caribbean efforts; effectively communicating both NOAA information to partners and partners' information to NOAA; and sharing, mobilizing, and integrating knowledge and expertise with regional partners and constituents in the Caribbean;
2. Attracting resources to address regional issues and needs in the Caribbean and developing initiatives using a unified and integrated approach; and
3. Helping NOAA achieve its mission and goals in the Caribbean, including support for the NOAA Caribbean Strategy.

Build Capacity

NOAA assists many Caribbean nations in building their capacity for anticipating and responding to hazards and catastrophic natural events, such as hurricanes and tsunamis, as well as supporting science-driven marine stewardship. Through these activities, NOAA also seeks to transfer techniques and best practices across the region to create a network of expertise and experience that works together to meet regional challenges. However, NOAA needs to be more strategic in how it assesses, aligns, and prioritizes its capacity-building activities in the region to ensure efficient and effective capacity-building investments for the most critical needs. This is integral to regional sustainability and effective long-term implementation of regional and NOAA goals.

Strengthen Science, Data Stewardship, and Applications

The need to increase the quality, quantity, usability, and accessibility of data is commonly identified through surveys and assessments, as is the need to better target science to address

⁹ See Southeast and Caribbean Regional Collaboration Team website: www.regions.noaa.gov/secar.

priority management challenges in the region. Better access to current research information and addressing gaps in data management planning, collection, documentation, and sharing on a regional scale will enhance the effectiveness of many NOAA domestic missions that rely on data obtained at a broader geographical scale, such as ocean observations, climate modeling, and fishery management. Opportunities exist to share and synthesize existing data to address important emerging regional issues such as ecosystem change and ecological connectivity.

NOAA is increasing efforts to be a national leader in providing access to data, science, and decision-support resources, as illustrated by its strong participation in development of the ocean data portal (the Ocean Community on Data.gov),¹⁰ an element of the National Ocean Council's implementation of the National Ocean Policy. The portal provides streamlined access to data, tools, and maps from many Federal agencies by making it accessible from a single, user-friendly site. In addition, NOAA's Southeast and Caribbean Data Explorer¹¹ provides access to a range of information focused on the U.S. Southeast and Caribbean region. NOAA also supports the NOAA Data Catalog¹² and the NOAA GeoPlatform,¹³ which together provides NOAA customers, partners, and staff members with a centralized platform for discovering and accessing much of NOAA's distributed geospatial data, services, and applications, as well as an easy-to-use online map and data viewer. NOAA's geospatial data, mapping, and visualization efforts, along with those of other Federal agencies, can all be found in the multi-agency National GeoPlatform.¹⁴ Finally, NOAA has developed a climate portal¹⁵ that provides an authoritative and trusted online source of climate data and information services for the interested public, educators, data users, and decision makers, helping to assess and understand the state of the climate system, regional impacts, and future projections.

Respect Diverse Cultures and History

The Caribbean is composed of a geopolitically complex suite of sovereign nations and territories, each with its own unique culture and history. To successfully implement the strategy's goals and objectives, NOAA must engage with a sensitivity that takes into account the diverse and unique languages, cultures, and experiences within the region, including the incorporation of traditional knowledge and practice.

Achieve Greater Continuity

The need for long-term planning and continuity spans many geographical areas and levels of management in the region. At the project level, monitoring studies in the region tend to be of short duration, often due to a lack of sustained funding. Continuity is often cited by scientists, managers, and other stakeholders as a concern in achieving coastal and environmental goals in the region. Strategic planning and securing long-term commitments to initiatives and partnerships are critical to achieving success.

¹⁰ www.data.gov/ocean

¹¹ www.csc.noaa.gov/secart

¹² data.noaa.gov

¹³ noaa.maps.arcgis.com/home/

¹⁴ www.geoplatform.gov

¹⁵ www.climate.gov

Strategic Goals and Objectives

The Caribbean Strategy encompasses three strategic goals, each with multiple objectives and initial and long-term actions:

- *Goal 1: Improved Conservation and Management of Ocean and Coastal Ecosystems and Resources*
- *Goal 2: Strengthened Understanding of, and Adaptation to, a Changing Climate*
- *Goal 3: Enhanced Multi-Hazard Monitoring, Forecasting, and Risk Management*

These goals are designed to focus NOAA's efforts, stressing the need for coordination and participation by all NOAA line offices and programs. The goals were based on the environmental issues and societal challenges of importance to the region, needs assessment information, consistency with and support for NOAA's NGSP and the National Ocean Policy, and the experience of individuals working in the region. In addition, the goals are complementary and interdependent, an important consideration in addressing certain cross-cutting issues such as sea level change. The initial actions generally target activities that may already be underway, can be addressed in the nearer term, build on existing efforts, or represent more urgent needs. The long-term actions target activities that may require significant additional resources and strengthened or new partnering. The actions in this strategy will be pursued subject to the availability of resources.



Goal 1: Improved Conservation and Management of Ocean and Coastal Ecosystems and Resources

Need and Challenge

Healthy and sustainable coastal landscapes and seascapes are essential to Caribbean community welfare and sustainable development. They benefit recreation and tourism, commercial industries, and the subsistence needs of populations. The region's coastal and marine environment contributes substantially to food supplies and supports the livelihoods of many people.¹⁶ In this region, about 43 million people live on the coast within 30 kilometers of a coral reef.¹⁷ Sustainable fisheries management is an important strategy for long-term food and economic security because some marine resources are in various stages of depletion.¹⁸ According to a review of the state of fisheries in the wider Caribbean region by the Western

¹⁶ Caribbean Sea Ecosystem Assessment (CARSEA), 2007, A sub-global component of the Millennium Ecosystem Assessment (MA), J. Agard, A. Cropper, K. Garcia, eds., Caribbean Marine Studies, Special Edition, 2007, 104 pp.

¹⁷ http://pdf.wri.org/reefs_at_risk_revisited.pdf, 2011, p.64

¹⁸ <http://sero.nmfs.noaa.gov/sf/CaribbeanStockStatus.htm>

Central Atlantic Fisheries Commission, the regional body of the United Nations Food and Agriculture Organization, a number of fishery resources in the Caribbean are known to suffer from overexploitation. Fisheries management in the region also faces unique challenges as the majority of fisheries are small-scale, with fishermen using multiple gear types to catch several different species of fish.



Caribbean coastal and marine water quality is affected by human activities, including land-based pollution and loss of wetlands and other key coastal features, both a result of coastal development. Studies show that an increase in suspended solids in the Caribbean's coastal and marine environment is causing threats to ecosystem health. Analysis of more than 3,000 watersheds across the region identified 20 percent of coral reefs at high risk and 15 percent at medium threat from damage caused by sediment and pollution from terrestrial sources, especially agriculture and other land modification.¹⁹ The insular Caribbean is

particularly threatened: from Jamaica through to the Lesser Antilles, more than 90 percent of all reefs are threatened, with nearly 70 percent classified as high or very high threat. Most of these areas are affected by multiple threats, led by coastal development and watershed-based pollution.²⁰ Effective water resource and coastal management measures, informed by knowledge of local conditions and challenges, are urgently needed to address these concerns.

The Caribbean region has many regional organizations or bodies creating a complex and sometimes disjointed governance structure to support the conservation and management of closely connected landscapes and seascapes and the services provided to communities. Improvements could be made to connect sub-regional organizations and activities with regional and international forums. In addition, for many locations, technical and financial resources are insufficient to conduct comprehensive ecological monitoring, modeling, and forecasting at the necessary scales and frequencies to inform adaptive management. Developing and implementing solutions with partners at a variety of scales (local, regional, and international) requires NOAA and other Federal agencies to increase the ability to understand and predict environmental changes, and manage resources in this region.

Examples of NOAA Engagement in the Region

NOAA participates in international treaties and partnerships to support regional marine resource conservation through the Cartagena Convention and its Protocols for Oil Spills, Specially

¹⁹ Burke, L., and Maidens, J., 2004. Reefs at risk in the Caribbean. World Resources Institute. 80 pp. http://pdf.wri.org/reefs_caribbean_full.pdf, pg. 12

²⁰ http://pdf.wri.org/reefs_at_risk_revisited.pdf, 2011, p.65

Protected Areas and Wildlife, and Land Based Sources of Pollution (LBSP). The United Nations Environment Programme (UNEP) is the designated Secretariat of the Cartagena Convention, which provides a legal framework to implement many of the region's cooperative conservation activities under the Caribbean Environment Programme. NOAA also contributes to the Global Environment Facility-sponsored Caribbean Large Marine Ecosystem project, which provides a foundation for trans-disciplinary and ecosystem-based management of shared living marine resources. It is a source for research into the status of, and threats to, marine resources and habitats across the region, and provides a science-to-policy interface to ensure that management decisions sustain the viability of the region's ecosystems.

Building on this initial trans-boundary approach, NOAA is partnering with the International Union for the Conservation of Nature, the International Oceanographic Commission's (IOC) Sub-commission for the Caribbean and adjacent regions, and other organizations and agencies to improve the long-term sustainability of resources and environments of the Caribbean Sea Large Marine Ecosystem.

NOAA's Coral Reef Conservation Program (CRCP) provides funding and technical assistance to U.S. domestic and international partners to catalyze coral reef stewardship and assembles expertise across the agency to provide a multidisciplinary approach to understand and manage coral reef ecosystems and address top coral reef threats: climate change, fishing impacts, and LBSP. The CRCP has engaged in considerable effort to develop 20-year strategic goals and five-year objectives to effectively address each of the top three threats to coral reef ecosystems, both domestic and internationally.²¹

A CRCP focus in the region is to support the UNEP Caribbean Environment Programme's Caribbean Marine Protected Area Management (CaMPAM) network of marine protected area (MPA) practitioners, which strengthens local MPA management capacity and improves coordination among MPA practitioners across the region. NOAA also works in the U.S. Caribbean as part of the U.S. Coral Reef Task Force to further the understanding and conservation of coral reef ecosystems. NOAA engages with the task force on a wide range of issues, including mapping and monitoring U.S. coral reefs, researching the causes of and solutions to coral reef decline, reducing and mitigating coral reef degradation from pollution, overfishing, and other causes, and implementing strategies to promote conservation and sustainable use of coral reefs internationally.



²¹ NOAA Coral Reef Conservation Program. 2009. NOAA Coral Reef Conservation Program Goals & Objectives 2010-2015. http://coralreef.noaa.gov/aboutcrctp/strategy/currentgoals/resources/3threats_go.pdf.

NOAA is developing indices and proxies to monitor and report on the ecological conditions and health of coastal ecosystems. NOAA is working with the territorial coastal programs and communities in the United States and wider Caribbean region to develop watershed management plans that will improve water quality, mitigate the impacts of invasive species, restore coastal habitats, and sustain natural resources.

As noted earlier, the fisheries sector is an important source of livelihoods and sustenance to the inhabitants of the region. NOAA's efforts in fisheries management, encompassing sustainable fisheries, protected species, and habitat conservation, are critical for economic and social development. Scientific products, information syntheses, and technical support, when coupled with local knowledge and targeted data collection, facilitate adaptive management and planning for the long-term use of coastal resources.

NOAA partners with the Caribbean Fishery Management Council to conserve and manage fishery resources within Federal waters of the U.S. Caribbean, providing information and expertise on decisions such as essential fish habitat designations, annual catch limits, and identification of ways to minimize the adverse effects of fishing activities on such habitat to preserve its ecological value in support of sustainable fisheries. NOAA has actively participated in broader regional efforts, such as the Western Central Atlantic Fisheries Commission, and sub-regional bodies such as OSPESCA (the Organization of the Fisheries and Aquaculture Sector in Central America) and the Caribbean Regional Fisheries Mechanism. Under the auspices of the Dominican Republic-Central America-United States Free Trade Agreement and with funding from the U.S. Agency for International Development (USAID) and the Department of State, NOAA has undertaken a significant amount of marine conservation work in the Caribbean coast of Central America. This work includes multiple training sessions in the use and enforcement of turtle excluder devices in shrimp trawl fisheries, the development of a program of fisheries monitoring, control, and surveillance, workshops on conducting inspections for illegal products in seafood processing plants, enforcement of shark laws and uses of technology in fisheries enforcement, and assistance for fisheries observers to monitor capture fisheries and provide technologies that mitigate incidental take in longline fisheries.

Strategic Approach: Objectives and Actions

Execution of this strategy provides an opportunity to enhance regional governance structures and reduce significant limiting factors for supporting improved conservation and management of ocean and coastal ecosystems and resources. Implementing these actions can help identify and prioritize issues, plan for integrative work, and advocate for policy, technical, and financial support. Through focused execution of mandates and regional and international collaboration, NOAA can, in partnership with others, work toward addressing these limitations.

Objective 1: Enhance and support capacity for ecosystem-based, sustainable management of marine resources to maintain or increase their ecological and economic value

INITIAL ACTIONS:

- Review documented needs for partnerships and training with agencies and communities to address the most urgent needs for managing coastal and marine resources.
- Increase partnerships with domestic and international entities and fishermen to collect, compile, synthesize, and share existing and new information including catch, economic, and community data, and invest in additional targeted fishery-independent data, syntheses of local ecological knowledge, and tools or guides for fishermen to collect such information.
- Create or enhance permit programs to develop and ensure access to accurate data on marine resource uses, including extraction.
- Increase participation in regional conservation efforts such as the International Commission for the Conservation of Atlantic Tunas (ICCAT), OSPESCA, and the Caribbean Regional Fisheries Mechanism.
- Collaborate on research to address harmful algal blooms and ciguatera and their impacts on living marine resources and human health.
- Establish and train response teams to identify and respond to living marine resource disease outbreaks, bleaching events, and physical impacts.
- Develop, with partners, management tools and a regional response strategy for invasive lionfish in the Caribbean.
- Contribute to development of the Caribbean Large Marine Ecosystem's Strategic Action Programme.

LONG-TERM ACTIONS:

- Identify priorities for biodiversity conservation in collaboration with Caribbean partners.
- Enhance capabilities to train interested parties to perform a biogeographic assessment of marine and coastal environments.
- Identify ecosystem indicators and establish technical and analytical capacity in the region to incorporate environmental, socioeconomic, climate, and living marine resource data.

- Provide expertise and training to map and characterize coral reef communities and nearshore, inshore, and marine habitats, update and analyze land cover imagery, and collaborate with local governments and international organizations to develop plans for long-term conservation and stewardship, including through protected areas and other place-based management schemes.
- Initiate and share the results of studies, in collaboration with local management organizations, on the effectiveness of various management scenarios and innovative approaches including co-management of resources, catch shares, and community-based strategies to support local fishing communities that have long depended on local stocks for subsistence, income, and employment, as well as other use sectors.
- Provide coordination, training, and capacity building for early detection and rapid-response to marine invaders in the Caribbean.
- Develop Environmental Response Management Application (ERMA) and early detection tools to identify marine toxins, and establish or maintain networks of response teams to investigate disease outbreaks, including the Caribbean Regional Response Team.
- Work regionally to encourage implementation of the Specially Protected Areas and Wildlife Protocol under the Cartagena Convention.

Objective 2: Reduce the negative impact of human activities on watersheds and coastal waters, and build capacity for improved marine and coastal resource management practices

INITIAL ACTIONS:

- Continue to develop and execute watershed management plans with local and regional partners; ensure plans are based on watershed data of sources, sinks, and problem areas.
- Implement priority protection and restoration actions, including those from the NOAA CRCP Goals and Objectives 2010-2015 document, in coordination with local and regional managers.
- Implement and share resource management case studies and best management practices related to impacts to essential fish habitats from coastal development and LBSP, and emphasize integrated ecosystem management approaches and coastal and ocean planning.
- Focus management on the full ridge-to-reef approach in priority areas in the U.S. Caribbean.
- Support networks (e.g., CaMPAM) to promote communication and learning exchanges and implement capacity-building initiatives for marine protected area managers.

LONG-TERM ACTIONS:

- Work regionally to address pollution and promote adherence to the LBSP Protocol and Oil Spills Protocol under the Cartagena Convention.
- Support port biological baseline surveys for ballast water management and control of invasive species.
- Develop best management practices, siting, and environmental monitoring and modeling methods for marine cage aquaculture operations for the U.S. Caribbean to minimize potential impacts on coral reef ecosystems, streamline the permitting process for aquaculture operators, and share with others in the region.
- Support establishment and provide for adequate management of existing national, regional, or sub-regional MPA networks, emphasizing ecological linkages and peer-to-peer learning exchanges to promote management capacity.
- Support training programs and learning exchanges to address priority management needs, including MPA enforcement, sustainable fishing, climate change, management planning, sustainable financing, and other topics to promote capacity for marine conservation.

Objective 3: Assist the conservation and recovery of species specially protected by laws or international protocols or forums

INITIAL ACTIONS:

- Avoid and minimize physical impacts to critical habitats and restore degraded ecosystem components to support species recovery.
- Support the United Nations Environment Programme's Caribbean Environment Programme, including the Specially Protected Areas and Wildlife Protocol, the Marine Mammal Action Plan, and the Listing of Species and Protected Areas.
- Execute actions to encourage protected species recovery via implementation of recovery plans.
- Promote technology transfer for bycatch reduction methods.
- Promote sister sanctuary relations in the region to foster protection of migratory species and other trans-boundary cooperation.
- Promote sharing of information and exchanges among practitioners, including those in non-sanctuary protected areas.

LONG-TERM ACTIONS:

- Inform and support conservation and recovery activities put forth by species conservation groups such as the International Union for the Conservation of Nature or treaties such as the Convention on International Trade in Endangered Species (CITES).
- With partners, support the development of monitoring and assessment tools (e.g., LifeWeb project) and a regional mechanism for tracking status and trends of specially protected species throughout their ranges, including under impacts of changing climate.

Objective 4: Increase the understanding of connectivity to improve management of living marine resources throughout the region

INITIAL ACTIONS:

- Compile existing population genetics and hydrodynamic monitoring and modeling studies on selected species to help understand the connectivity patterns and processes that link marine stocks, and identify gaps for future research emphasis.
- Support the United Nations efforts toward a Global Marine Assessment within the region via IOC Sub-commission for the Caribbean and Adjacent Regions (IOCARIBE) collaborations.

LONG-TERM ACTIONS:

- Evaluate the size, distribution, connectivity, and management effectiveness of MPAs in the region, and encourage development of a functional network.
- Conduct and/or participate in bilateral or multilateral research and assessments on species of mutual interest such as sharks, grouper, snapper, tunas, billfish, spiny lobster, reef fish, sea turtles, queen conch, and corals.
- Improve our understanding of habitat connectivity and fish movements among habitats and ontogenetic patterns among cross-shelf and nearshore habitats.

Objective 5: Increase abilities of Caribbean region nations to maintain the flow of ecosystem goods and services to sustain and improve their economies and well-being

INITIAL ACTIONS:

- Implement habitat protection and restoration projects that enhance economic opportunities, ecosystem integrity, and resilience to hazards.

- Provide technical capacity and assistance to implement innovative management approaches to support local coastal communities, such as within the fishing, aquaculture, and tourism industries.

LONG-TERM ACTIONS:

- Continue to work with partners to compile biophysical and socioeconomic baselines and develop natural resource valuations of Caribbean ecosystem goods and services to better understand the economic and social benefit of resources and the costs of unsustainable management.
- Foster sustainable aquaculture practices and implement best management practices for aquaculture to minimize impacts to coastal and marine resources.
- Build hydrographic capacity to better support navigation in the region and partner with tourism boards and companies including cruise lines to enhance sustainable waterfronts and promote multi-use, diverse economies.

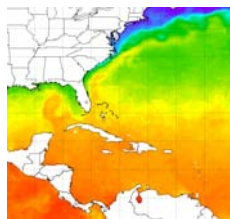
Objective 6: Develop and enhance partnerships to advance regional governance and the sustainable management of Caribbean marine resources

INITIAL ACTIONS:

- Consistent with the National Ocean Policy, support ongoing development of a Caribbean regional ocean partnership to help agencies, territories, countries, and organizations jointly address ocean and coastal challenges.
- Work with U.S. Coral Reef Task Force partners and the Caribbean Coral Reef Protection Group to continue to engage Federal, territorial and local governments in identifying and addressing the priority issues of the Caribbean.

LONG-TERM ACTIONS:

- Enhance fisheries regulatory compliance through increased enforcement capacity, and strengthen and leverage joint enforcement agreements with other governments.
- Actively participate in the Global Environment Facility-sponsored Caribbean Large Marine Ecosystem project and partner with regional organizations to improve coordination and decision-making at the project's regional level and through sub-regional level institutions.



Goal 2: Strengthened Understanding of, and Adaptation to, a Changing Climate

Need and Challenge

The Caribbean region is vulnerable to the impacts associated with climate-related processes, including sea level changes, warming sea surface and air temperatures, changes in storm frequency and severity, ocean acidification, coral bleaching, coral and fish diseases, and changes in weather patterns and water availability. Climate variability and change affects economic growth and sustainability within the region, especially for many small island nations. A strengthened scientific understanding of current and future climatic conditions and within-region variability, including socioeconomic and environmental impacts, and the potential application of this integrated information for adaptive responses is essential to increasing regional resilience and sustainability.

The Caribbean region experienced sea level rise of as much as 10 centimeters during the 20th century.²² The region, particularly areas that are low-lying or have limited natural coastline protection, is vulnerable to additional changes in sea level and storm intensity and frequency. The impacts of sea level rise are likely to include more extensive coastal flooding, inundation, erosion, and loss of mangroves and other threatened wetlands, especially in areas where the



coastal zone has been extensively modified by humans. For Caribbean Community and Common Market (CARICOM) nations, a 1 meter rise in sea level is predicted to result in a loss in gross domestic product of U.S. \$1.2 billion per year, displacement of more than 245,000 people, and permanently lost land valued at approximately U.S. \$70 billion.²³

Many Caribbean societies depend on reefs for food, tourism, and hazard protection. Climate change impacts have been identified as one of the most serious global threats to coral reef ecosystems, which are already imperiled region-wide due to a relentless combination of

²² IPCC AR4 WG2. 2007. Parry, M.L.; Canziani, O.F.; Palutikof, J.P.; van der Linden, P.J.; and Hanson, C.E., ed., *Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Cambridge University.

²³ Simpson, M.C., Scott, D., New, M., Sim, R., Smith, D., Harrison, M., Eakin, C.M., Warrick, R., Strong, A.E., Kouwenhoven, P., Harrison, S., Wilson, M., Nelson, G.C., Donner, S., Kay, R., Geldhill, D.K., Liu, G., Morgan, J.A., Kleypas, J.A., Mumby, P.J., Palazzo, A., Christensen, T.R.L., Baskett, M.L., Skirving, W.J., Elrick, C., Taylor, M., Magalhaes, M., Bell, J., Burnett, J.B., Rutty, M.K., and Overmas, M., Robertson, R. 2009. *An Overview of Modelling Climate Change Impacts in the Caribbean Region with contribution from the Pacific Islands*, United Nations Development Programme (UNDP), Barbados, West Indies.

stressors. Mass coral bleaching and disease outbreaks may become more frequent and severe as water temperature rises. Ocean acidification resulting from increased carbon dioxide has already begun to reduce calcification rates in reef-building and reef-associated organisms by altering sea water chemistry. By 2030, climate-related threats are projected to be high along the mainland coast from Mexico to Colombia, due to the confluence of thermal stress and acidification threats. Thermal stress is also projected to be high in the eastern Caribbean. Climate-related threats are projected to push the proportion of reefs at risk to 90 percent in 2030, and up to 100 percent by 2050, with about 85 percent at high, very high, or critical levels.²⁴

Changing climate may result in changes to weather patterns that operate across a range of spatial (local, regional) and temporal (seasonal, decadal) scales. Potential increases in hurricane strength or frequency could add socioeconomic stress to coastal communities. Waves and tidal surges will increase due to sea level rise. The Caribbean is at significant risk because of changes in precipitation patterns, underscoring the need for improved decision-support services. The likelihood of more intense droughts from decreased rainy season lengths and increased dry season lengths will negatively impact the agricultural sector, which employs approximately 30 percent of the Caribbean labor force. Flooding caused by a predicted increase of intense rains can also lead to more freshwater-induced floods and landslides, phenomena that are responsible for some of the largest losses of life in the Caribbean over the last 50 years.²⁵ These combined threats, and the unique risks associated with the Caribbean region, underscore the urgency for strengthening the region's ability to understand and respond to climate threats and impacts.

Many groups in the Caribbean are challenged by limited capacity to produce or manage the sophisticated network of information systems necessary to respond to and address climate change risk. The region is also faced with the difficult task of formulating adaptive strategies to address cumulative impacts of a changing climate in order to maintain the resilience of natural resources and economically important sectors (e.g., tourism, agriculture) against threats. Additionally, traditional coastal management systems often are ill equipped to articulate and address the increased risks and vulnerability associated with climate change. NOAA must work with partners in the implementation of a cross-cutting regional approach to address challenges from climate change in the Caribbean, where no single authority is either responsible for these issues nor necessarily has the capacity to address them. NOAA can also help support and contribute to existing national climate adaptation plans identified throughout the Caribbean.

Examples of NOAA Engagement in the Region

NOAA has a long history of collaboration in the Caribbean related to climate. Today, NOAA conducts research based on models and observations to understand and characterize the role of the oceans and atmosphere in climate variability and change. This research and the underlying

²⁴ Burke, L., Reytar, K., Spalding, M., and Perry A. 2011. *Reefs at Risk Revisited*. World Resources Institute, Washington. 130 p. http://pdf.wri.org/reefs_at_risk_revisited.pdf.

²⁵ Pulwarty, R., Nurse, L., and Trotz, U. Nov-Dec, 2010. *Caribbean Islands in a Changing Climate*. Environment: Science and Policy for Sustainable Development. www.environmentmagazine.org/Archives/Back%20Issues/November-December%202010/caribbean-islands-full.html.

observations include programs that are either inclusive of the Caribbean or are hemispheric to global in scope. Caribbean-centric examples include the Ocean Acidification Product Suite for the Caribbean and coral reef habitat mapping and classification. Programs and observation capabilities that are hemispheric or global in scope and apply to the Caribbean include the Climate Variability and Predictability (CLIVAR) CO₂ repeat hydrography program, the global drifter program, and the Meridional Overturning Circulation and Heat-Flux Array (MOCHA).

NOAA's climate research, models, and observations are transferred to operational and outreach products and services for the Caribbean. Operational products include constantly evolving hurricane prediction and tracking tools which provide early warning and save lives in areas threatened. NOAA's ecosystem decision-support systems such as the Integrated Coral Observing Network (ICON) and the Coral Reef Watch (CRW) suite of products utilize remote sensing and in-situ tools and data to provide resource managers near-real-time and long-term monitoring, modeling, and reporting of physical environmental conditions of coral reef ecosystems. NOAA assists in building local capacity to help communicate science findings to stakeholders through graduate-level training of regional resource managers in collaboration with the University of the West Indies and participation in the Caribbean Regional Climate Outlook Forum (CariCOF), which produces seasonal outlooks that aid in decision-making and planning. NOAA also supports activities in the Caribbean conducted by the International Research Institute for Climate and Society (IRI), including the development of integrated applications tools, as well as training and capacity building.

Next steps in this region are being discussed with USAID that would be conducted via the next phase of the NOAA Climate Program Office's international program, the International Research and Applications Project (IRAP). The IRAP is intended to be an international mechanism for interpreting and translating NOAA's (and that of other U.S. government and international entities, where appropriate) evolving climate information products and services—including training and capacity building—and for collaborating with partners to integrate the applications, impacts assessment, and decision-support research. In addition, NOAA is working with the Caribbean Community Climate Change Centre (CCCCC) on implementation plans to support regional adaptation strategies that were adopted by the Caribbean Community and Common Market (CARICOM) heads of state in 2009. Specifically, NOAA is assisting with the development and coordination of research teams to develop regionally specific methods to assess vulnerability and capacity in Caribbean Islands. NOAA is working with its coastal management programs to promote and encourage the revision of territorial coastal shoreline management policies to better consider climate change as well as develop territorial or community-level adaptation plans.



Strategic Approach: Objectives and Actions

The Caribbean is an interconnected ecosystem, and climate change impacts will often be expressed basin-wide. Integrating with regional partners to enhance our understanding of the changing climate system and its impacts not only helps NOAA meet its long-term goals, but also contributes to basin-wide decision-making to reduce the impacts of climate on lives, livelihoods, resources, and property. NOAA can advance this goal by improving the scientific understanding of the changing climate system in the Caribbean, including how resources and ecosystems are vulnerable to and impacted by climate change and variability; supporting adaptation and mitigation choices through sustained, reliable, and timely climate services; and fostering a climate-literate public that understands its vulnerabilities to a changing climate and is able to make informed decisions.

An effective bridge is needed between projects, tools, learning, and action, including through building networks of experts for current and future collaborations, and linking closely to the goals of Caribbean regional development strategies and to the objectives of other frameworks in which the U.S. government or NOAA is a signatory (e.g., Global Framework for Climate Services). Lessons learned must be transferrable, for example concerning drought early warning information from one region to another, by understanding local and regional decision processes and networks and identifying entry points for embedding climate risk information in practice; determining specific information characteristics (variables, lead times) required by the principal user communities in at-risk locations; assessing the spatial distribution of risk and the magnitude and frequency of events likely to occur; and identifying the needs for cross-sectoral approaches and information, as well as management mechanisms that bridge water, food, and energy security needs for the region.

NOAA is an international and regional leader in climate services and must continually strive for advances in multidisciplinary science and capacity building that inform and support decision-making and sustainable management. While high-quality regional climate science and impact assessments, as well as communication of scientific results with confidence, are necessary to make informed decisions for climate adaptation, direct engagement and feedback from decision makers and resource managers is required throughout the process to ensure that climate information is relevant and used effectively.

Objective 1: Improve scientific understanding and prediction of changing climate in the Caribbean

INITIAL ACTIONS:

- Build capacity to ensure that climate observing and early warning information systems in the Caribbean are integrated, maintained, and enhanced, and the state of the climate system can be routinely monitored.
- Leverage existing and explore new techniques to integrate in-situ measurements with satellite observations to increase the usage of remote-sensing data in the Caribbean.

- Improve scientific understanding of climate-related atmospheric and oceanic processes, including extremes and thresholds across climate timescales, through advances in research and modeling, both descriptive and predictive.
- Continue efforts to improve the spatial positioning framework and ties to enhanced water level networks.

LONG-TERM ACTIONS:

- Sustain and expand high-quality oceanic, atmospheric, and terrestrial climate observations at the regional and global scale, including contributions to the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the Caribbean Regional Association (CaRA) for Coastal Ocean Observing, which has guided the development of the Caribbean Coastal Ocean Observing System (CariCOOS).
- Establish a regional observation network that addresses gaps and enables comprehensive assessments of environmental change at the regional and local levels (e.g., local sea level change) and can be used to meet needs for planning and adaptation.
- Develop next-generation climate and climate impact models that reduce uncertainty over multiple spatial and temporal scales at the regional level.
- Establish regional Integrated Water Resources Science and Services (IWRSS) for real-time management of observations and model forecasts to strengthen regional resilience.
- Interpret and translate climate information, products, and capabilities across multiple time scales for up to three regions, beginning with seasonal-to-interannual and extending to multi-decadal timescales and beyond. This information should be integrated with targeted impact assessment, vulnerability research, and risk characterization.

Objective 2: Improve scientific understanding of how Caribbean resources and ecosystems are impacted by a changing climate

INITIAL ACTIONS:

- Conduct research related to climate forcing on coastal and marine ecosystems, including for ocean acidification, coral bleaching, sea level rise, ocean warming, and extreme events.
- Increase research on the linkage between climate and ecosystem processes and variables (e.g., thresholds, adaptation rates), including human systems and their dependencies on ecosystem services.

- Improve understanding and forecasting of the impacts of thermal stress, including responses such as bleaching of coral reef ecosystems in the Caribbean.
- Develop models of ecosystem response from projected changes in sea level, storm intensity and erosion, temperature change, and circulation patterns for sensitive coastal areas, managed areas, and species.

LONG-TERM ACTIONS:

- Increase research on the linkage between climate change, critical societal needs (e.g., fresh water resources), and community livelihoods.
- Improve understanding and prediction of the responses of marine and coastal species to a changing climate, including impacts to life-history characteristics, structure and function, and potential shifts in habitat and species distribution.
- Support understanding of “blue carbon,” the carbon sequestration capacity of coastal ecosystems, including mangrove, sea grass, and tidal marsh habitats.
- Develop and use advanced ecosystem modeling techniques that fully incorporate climate parameters and are refined to improve predictions and early warnings of local, as well as regional, conditions.

Objective 3: Support adaptation and mitigation options through sustained, reliable, and timely climate services

INITIAL ACTIONS:

- Build on existing vulnerability assessments and perform new ones as needed to identify Caribbean-specific needs and risks related to climate change and variability.
- Build local and regional capacity in conducting climate risk and vulnerability assessments through continued support of professional training, promoting the use of these assessments and related tools in integrated coastal zone and watershed management, disaster risk reduction, energy development, and other adaptation planning mechanisms.
- Produce weather and climate hazard outlooks that focus on extreme events such as droughts, floods, and tropical cyclones.

LONG-TERM ACTIONS:

- Develop information, tools, and guidance related to climate impacts and vulnerabilities of human and natural systems to inform and support mitigation and adaptation to climate change.
- Develop projections of changes in ecosystem services due to climate change at scales relevant to stakeholders in the region.
- Develop a sustained and credible process to produce early warning systems across relevant climate time scales through the collaborative CariCOF to provide input for preparedness, risk reduction, and adaptation activities relevant to critical sectors (e.g., tourism, agriculture) supported by the IRAP, among other NOAA programs.
- Embed climate risk information into existing local and regional decision processes.

Objective 4: Foster a climate-literate public that understands its vulnerabilities to a changing climate and is able to make informed decisions

INITIAL ACTIONS:

- Create and enhance access to an array of multilingual climate information and data for all levels of society.
- Increase awareness of climate information on NOAA websites and portals such as climate.gov, drought.gov, coralreefwatch.noaa.gov, and others for use by Caribbean partners.
- Conduct workshops for and with resource managers, planners, program administrators, policy makers, and media and information networks on potential climate impacts, planning for climate change, designing and using risk and vulnerability assessments, and adapting to climate change for coastal communities and ecosystems.

LONG-TERM ACTIONS:

- Increase comprehension and common use of climate science concepts and education resources among educators and other outreach professionals.
- Assist coastal and ocean managers in developing public and formal communications and education materials (national and regional) regarding the impacts of climate change on coral reefs, watersheds, and coastal communities, and in translating science and management goals and initiatives for identified audiences.

- Design, coordinate, implement, and contribute technical expertise to capacity-building and training efforts, in partnership with other organizations such as USAID, the World Bank, and the World Meteorological Organization (WMO), focused on enhancing the institutional and technical foundations for international and regional climate services for adaptation. A significant portion of the outreach, training, and capacity-building activities should be targeted toward use of the information by technical decision-making and policy-relevant organizations.
- Work to enhance NOAA participation in the authorship and leadership committees of the Southeast and Caribbean National Climate Assessment conducted periodically by the U.S. Global Change Research Program.



Goal 3: Enhanced Multi-Hazard Monitoring, Forecasting, and Risk Management

Need and Challenge

The Caribbean faces pronounced natural and anthropogenic threats, and requires resources to strengthen physical, economic, and social resilience. Risk management and community resilience are concepts and practices that have yet to be fully realized. Significant natural threats include hurricanes, storm surge and event-related coastal and inland flooding, wave erosion, tsunamis, drought, earthquakes, volcanism, landslides, and marine toxins. Insufficient monitoring data, high-resolution bathymetry and topography, localized models and tools, multi-hazard early warning systems, and outreach capacity are frequently cited as challenges confronting Caribbean nations in creating more hazard-resilient communities. Gaps in training, risk awareness education, and communication hinder the effective sharing of information.



Given the high degree of physical and ecological connectivity among the Caribbean, Gulf of Mexico, and mainland United States, the United States has a strong interest in safeguarding life and property of its citizens and neighbors, and preparing for and minimizing the impacts of weather-related and other natural and anthropogenic stressors in the region. Currently, the resources used to respond to and recover from disasters far outweigh those invested in proactively preparing for and mitigating their impacts.

The economies of the Caribbean are heavily dependent on maritime transportation and tourism. The volume of vessel traffic in the Caribbean is increasing dramatically, leading to greater risk of accidents and injury to lives, property, livelihoods, and natural resources. Many Caribbean countries have limited fiscal resources, equipment, or technical expertise, which impedes their ability to collect and maintain necessary hydrographic data and physical oceanographic real-time services for safe and efficient maritime operations. As a result, both commercial and cruise vessels risk groundings and accidents, oil and chemical spills, and damages to the environment. Tourism represents 31 percent of the gross domestic product and supports nearly 3 million jobs. During 2010, almost 20 million people vacationed in the Caribbean, while another 20 million arrived on cruise ships, with U.S. tourists accounting for almost 50 percent of the stopover visits and close to 90 percent of cruise ship passengers.²⁶ Managing hazard risks across these economic sectors, while encouraging sustainable tourism practices, provides for both human protection and economic opportunity, while sustaining the resources valued by both visitors and residents.

Examples of NOAA Engagement in the Region

In recent years, NOAA and other agencies have tried to address regional challenges and customer needs for ocean observations and geospatial data in the U.S. Caribbean. The Caribbean Regional Association (CaRA) for Coastal Ocean Observing is developing an observing system for the region. CaRA's programming has potential application for the broader region and may serve as a catalyst for initiating an integrated and sustainable regional observation system that provides economic, security, environmental, and conservation benefits. With respect to maritime traffic, the NOAA Restoration Center in Puerto Rico and the U.S. Virgin Islands has been very active in responding to vessel groundings.

NOAA's National Hurricane Center (NHC) works with partners in the Caribbean to coordinate hurricane analyses, forecasts, watches, and warnings. The NHC and the WMO Regional Specialized Meteorological Center in Miami provide year-round operational support through marine forecasts of wind, seas, and weather. The NHC also coordinates with member nations of the National Meteorological and Hydrologic Services to provide advisory and warning services throughout the region. NOAA undertakes projects and training programs as part of its outreach activities and as part of the U.S. contribution to the WMO's Voluntary Cooperation Program. In addition, CariCOF provides outlooks and information on potential heavy rainfall seasons and drought and their impacts over seasons. This effort may be



²⁶ Caribbean Tourism Organization, 2010 Statistics (includes Stop-over and Cruise Passengers), www.onecaribbean.org/content/files/June8Lattab10.pdf, downloaded August 19, 2011. These statistics do not include the Caribbean coasts of South and Central America.

expanded to include forecasting and impacts in coastal and marine environments with other NOAA and regional partners.

NOAA participates in the Intergovernmental Oceanographic Commission to address needs for tsunami planning and response, and provides interim warning services. This engagement is crucial for plans for a future tsunami warning system in the region. NOAA's Caribbean Tsunami Warning Program was established in 2010 as the first step of a phased approach for a Caribbean Tsunami Warning Center, supporting ocean and geophysical observations, as well as tsunami research and readiness.

In addition to addressing natural hazards, NOAA's Office of Response and Restoration is engaged in emergency preparedness and response projects in the region, such as the ongoing project with the Panama Canal Authority promoting oil and hazardous material spill preparedness and response. This project promotes the utilization of state-of-the-art procedures, methods, and technologies for planning and preparedness for oil and hazardous materials spills and releases, including training, drills, exercises, and data sharing.

NOAA also provides satellite-based observations for the region. The GEONETCast Americas system compiles and disseminates satellite and in-situ products for the topical areas of weather, climate, disasters, agriculture, health, energy, biodiversity, water, and ecosystems.

Strategic Approach: Objectives and Actions

Goal 3 describes objectives and actions to help realize a Caribbean region that is more sustainable and resilient to hazards and disasters. To address emerging issues and longer-range chronic threats to the region, the strategies and actions outlined here build on existing efforts and also emphasize data sharing, socioeconomic valuation, vulnerability assessment, training, risk communication, and capacity building in applying existing best management practices and decision support for land use and infrastructure development, as well as all-hazards risk preparedness and mitigation.

The range of NOAA authorities and capabilities in atmospheric, coastal, and ocean science, navigation and positioning, resource management, habitat conservation, decision support, technical assistance, and training provide a powerful combination to enable communities to advance their resilience goals. NOAA is skilled at identifying risks and vulnerabilities and working with decision makers to apply sustainable solutions that increase resilience to the impacts of climate change, extreme weather, coastal inundation, oil and chemical spills, and other hazards and environmental stressors.

Strategic alignment in this area with partners offers an excellent opportunity to help Caribbean communities improve their environmental, economic, and social resilience to hazards, for example through the United Nations International Strategy for Disaster Reduction. At the national level, Presidential Policy Directive-8 on National Preparedness promotes broad coordination on the threats that pose the greatest risk to the security of the nation, including those from natural disasters. It highlights that preparedness is the shared responsibility of all levels of

government, the private and nonprofit sectors, and citizens, and communicates the goal of “*a secure and resilient Nation with the capabilities required across the whole community to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk.*”

Objective 1: Build technical capabilities to use sea level, meteorological, hydrographic, and spatial positioning services

INITIAL ACTIONS:

- Collaborate with Caribbean countries that have hydrographic expertise and expand existing hydrographic training opportunities to include more participants from Caribbean countries.
- Establish a regional integrated data management system to facilitate data sharing and organizational communication processes, in coordination with existing NOAA (and other Federal agency) data management priorities (e.g., National Ocean Council ocean data portal, NOAA GeoPlatform, and Integrated Water Resources Science and Services).

LONG-TERM ACTIONS:

- Assist development of a modernized and sustainable sea level, meteorological, hydrographic survey, and geodetic reference framework for, and with, the region.
- Provide assistance to Caribbean countries in identifying and applying to international donor organizations for the acquisition of modern hydrographic survey equipment and coastal ocean observing systems, as well as associated training for those technologies.
- Provide expertise, training, and equipment to advance seafloor mapping in the U.S. Caribbean and for priority sites across the region.

Objective 2: Increase technical capacity for environmental monitoring and forecasting to increase resilience of Caribbean communities

INITIAL ACTIONS:

- Improve weather and tsunami operational warning, forecast, and decision-support service capabilities for the Caribbean.
- Maintain and expand water level and geophysical observation stations, and the archiving, quality control, and dissemination of the data.

- Assist national hydro-meteorological services in developing full access to radar data in real time.

LONG-TERM ACTIONS:

- Share expertise in operational forecasting through training with weather forecasters via tele-training and Internet-based training opportunities.
- Implement region-wide composite graphics, including radar, to better highlight ongoing weather threats.
- Develop a regional archive of sea level and meteorological data for multipurpose applications.

Objective 3: Assist governments in integrating social science and socioeconomic factors into disaster and emergency planning

INITIAL ACTIONS:

- Monitor and analyze trends in socioeconomic data, and enhance development and application of county-level demographic, infrastructure, and environmental information within flood zones.
- Broaden the utility and use of weather, climate, and water-related outputs for decision-making and implementation by national hydro-meteorological services and partner organizations.
- Leverage existing risk communication best practices.
- Support NOAA's sustainable tourism assistance to the region to promote wise use and stewardship of resources that stimulate the economy for the long term.

LONG-TERM ACTIONS:

- Increase capacity for monitoring long-term trends in socioeconomic data, conduct analyses, and provide resource planning tools to help governments and local communities advocate for sustainable and disaster-resilient communities and waterfronts encompassing diverse uses such as fishing, marinas, shops and restaurants, tourism, and public access.

Objective 4: Enhance the capacity for multi-hazard disaster preparedness in the Caribbean region

INITIAL ACTIONS:

- Develop regional and island-specific storm surge and tsunami modeling capabilities to address multiple marine hazards.
- Continue efforts of the NHC to support improved storm and hurricane preparedness throughout the region.
- Continue efforts under NOAA’s Caribbean Tsunami Warning Program and Tsunami Warning Centers to establish a sufficient tsunami detection, warning, outreach, and education capacity in the Caribbean that benefits U.S. domestic as well as broader regional interests.
- Increase dissemination of timely and effective warnings and forecasts.
- Enlist NOAA assets and local and regional experts to assist with educating the public and emergency managers to provide a better understanding of hurricane hazards and storm surge watches, warnings, and decision-support products.
- Work with Federal agencies and Caribbean partners to enhance understanding of, and promote coordination and capacity building through, key national planning frameworks under Presidential Policy Directive-8 of mitigation, response, and recovery.

LONG-TERM ACTIONS:

- Expand the use of ERMA to develop a Web-based GIS data delivery system integrating traditional and real-time data sets for Caribbean countries to conduct emergency response, environmental assessment, monitoring, and planning.
- Collaborate with the United Nations Environment Programme Regional Activity Center/Regional Marine Pollution Emergency Information and Training Center – Wider Caribbean Region on training activities.
- Connect planners, community developers, and disaster and resource managers to coastal community resilience information and tools for enhancing resilience to hazard risks, and integrate concepts into local projects, plans, policies, and training programs.
- Utilize high-resolution coastal-use and altimetry mapping to assess vulnerable (inundation) areas and establish early warning systems to facilitate coastal community disaster planning and response.

- Leverage technical and capacity advancements in tidal, hydrographic, and geodetic reference frameworks throughout the Caribbean region to support hazard impact prediction and response strategies.
- Improve impact-based decision-support services through the use of weather and water-related forecasts and warnings to enhance decision-making and prevent and mitigate short- and medium-term hazards.
- Provide technical expertise to identify, restore, and create more sustainable and resilient coastal habitats and promote green infrastructure solutions to enhance resilience to hazards.

Implementation and Evaluation

To the best of its abilities, and subject to government-wide budget constraints, NOAA will seek to implement the initial actions of the Caribbean Strategy over the coming years. Detailed information for executing actions will be developed by those implementing specific activities. During this period, the strategy will be reviewed by compiling achievements, analyzing gaps in implementation, and re-evaluating priorities and actions for consistency with the needs of the Caribbean region and broader NOAA strategic priorities, plans, and budgets. The long-term actions within the strategy will require more deliberate and longer-range planning, including considerations for impacts to the overall NOAA budget and opportunities to potentially redirect or focus resources on the Caribbean region.

To most effectively execute the Caribbean Strategy, NOAA must continually affirm strategic and program priorities; align functions, resources, and work units to meet core responsibilities; and identify and act on opportunities for broader regional collaboration, partnership building, and resource leveraging. Through this strategy, NOAA can plan and execute more effectively while responding to evolving customer requirements, as well as administration and congressional expectations. The strategy strongly supports two of the NOAA NGSP engagement enterprise objectives: 1) integrated services meeting the evolving demands of regional stakeholders; and 2) full and effective use of international partnerships and policy leadership to achieve NOAA's mission objectives. Participants in NOAA's regional collaboration effort, including the Southeast and Caribbean regional collaboration team, as well as the NOAA in the Caribbean steering committee, are well positioned to help support the execution of the Caribbean Strategy through encouraging consistent internal and external communication and coordination, working to attract resources to address issues, and fostering initiatives using an integrated approach.

A key aim of the strategy is to improve integration and create efficiencies internal to NOAA, as well as with Caribbean partners and constituents. In a time of austere budgets, collaboration and partnership is an especially important business approach to help ensure the viability of efforts.

The strategy underscores the need for enhanced and new collaborations that promote integration and help ensure that resources are effectively utilized. Although such collaboration requires sustained energy and commitment, the benefits can be substantial, leading to leveraging of scarce resources, development of trusted relationships, and ultimately achieving mission objectives that could not be achieved alone. By emphasizing integration and collaboration that is focused within the Caribbean region, NOAA can:

- Create a more results-oriented agency by orienting efforts on the ground to meet targeted, measurable outcomes;
- Enhance the ability to communicate and collaborate with regional and local networks, as well as other agency programs;
- Foster opportunities for NOAA programs to connect more effectively to Caribbean communities to deliver services and information;
- Improve the ability to build partnerships and achieve collaborative results by incorporating regional intelligence in development, delivery, and feedback processes; and
- Facilitate activities in collaboration with other offices and partners (including staff co-location) for the purpose of providing better products and services to constituents.

The process of engaging in continuous improvement is what makes a good organization great. As the strategy is implemented, it will be important to evaluate progress toward achieving the three goals. Formal and informal methods will be used to track Caribbean Strategy progress. Needs assessments and feedback from partners and users at multiple levels will help inform the development and refinement of activities, products, and services. These efforts, combined with synthesis and assessment, will inform the setting of priorities for NOAA actions and the development of policy and program guidance. A variety of tools can be employed along the evaluation spectrum to better understand the impacts of efforts, including anecdotal data from the users of science, products, and services, performance metrics, surveys, social media, literature reviews, interviews, review panels, and partner feedback.