20 U.S. Caribbean

San Juan, Puerto Rico

Key Message 1

Freshwater

Freshwater is critical to life throughout the Caribbean. Increasing global carbon emissions are projected to reduce average rainfall in this region by the end of the century, constraining freshwater availability, while extreme rainfall events, which can increase freshwater flooding impacts, are expected to increase in intensity. Saltwater intrusion associated with sea level rise will reduce the quantity and quality of freshwater in coastal aquifers. Increasing variability in rainfall events and increasing temperatures will likely alter the distribution of ecological life zones and exacerbate existing problems in water management, planning, and infrastructure capacity.

Key Message 2

Marine Resources

Marine ecological systems provide key ecosystem services such as commercial and recreational fisheries and coastal protection. These systems are threatened by changes in ocean surface temperature, ocean acidification, sea level rise, and changes in the frequency and intensity of storm events. Degradation of coral and other marine habitats can result in changes in the distribution of species that use these habitats and the loss of live coral cover, sponges, and other key species. These changes will likely disrupt valuable ecosystem services, producing subsequent effects on Caribbean island economies.

Key Message 3

Coastal Systems

Coasts are a central feature of Caribbean island communities. Coastal zones dominate island economies and are home to critical infrastructure, public and private property, cultural heritage, and natural ecological systems. Sea level rise, combined with stronger wave action and higher storm surges, will worsen coastal flooding and increase coastal erosion, likely leading to diminished beach area, loss of storm surge barriers, decreased tourism, and negative effects on livelihoods and well-being. Adaptive planning and nature-based strategies, combined with active community participation and traditional knowledge, are beginning to be deployed to reduce the risks of a changing climate.

Key Message 4

Rising Temperatures

Natural and social systems adapt to the temperatures under which they evolve and operate. Changes to average and extreme temperatures have direct and indirect effects on organisms and strong interactions with hydrological cycles, resulting in a variety of impacts. Continued increases in average temperatures will likely lead to decreases in agricultural productivity, changes in habitats and wildlife distributions, and risks to human health, especially in vulnerable populations. As maximum and minimum temperatures increase, there are likely to be fewer cool nights and more frequent hot days, which will likely affect the quality of life in the U.S. Caribbean.

Key Message 5

Disaster Risk Response to Extreme Events

Extreme events pose significant risks to life, property, and economy in the Caribbean, and some extreme events, such as flooding and droughts, are projected to increase in frequency and intensity. Increasing hurricane intensity and associated rainfall rates will likely affect human health and well-being, economic development, conservation, and agricultural productivity. Increased resilience will depend on collaboration and integrated planning, preparation, and responses across the region.

Key Message 6

Increasing Adaptive Capacity Through Regional Collaboration

Shared knowledge, collaborative research and monitoring, and sustainable institutional adaptive capacity can help support and speed up disaster recovery, reduce loss of life, enhance food security, and improve economic opportunity in the U.S. Caribbean. Increased regional cooperation and stronger partnerships in the Caribbean can expand the region's collective ability to achieve effective actions that build climate change resilience, reduce vulnerability to extreme events, and assist in recovery efforts.

Executive Summary

Historically, the U.S. Caribbean region has experienced relatively stable seasonal rainfall patterns, moderate annual temperature fluctuations, and a variety of extreme weather events, such as tropical storms, hurricanes, and drought. However, the Caribbean climate is changing and is projected to be increasingly variable as levels of greenhouse gases in the atmosphere increase.

The high percentage of coastal area relative to the total island land area in the U.S. Caribbean means that a large proportion of the region's people, infrastructure, and economic activity are vulnerable to sea level rise, more frequent intense rainfall events and associated coastal flooding, and saltwater intrusion. High levels of exposure and sensitivity to risk in the U.S. Caribbean region are compounded by a low level of adaptive capacity, due in part to the high costs of mitigation and adaptation measures relative to the region's gross domestic product, particularly when compared to continental U.S. coastal areas.[1] The limited geographic and economic scale of Caribbean islands means that disruptions from extreme climate-related events, such as droughts and hurricanes, can devastate large portions of local economies and cause widespread damage to crops, water supplies, infrastructure, and other critical resources and services.[1]

The U.S. Caribbean territories of Puerto Rico and the U.S. Virgin Islands (USVI) have distinct differences in topography, language, population size, governance, natural and human resources, and economic capacity. However, both are highly dependent on natural and built coastal assets; service-related industries account for more than 60% of the USVI economy. Beaches, affected by sea level rise and erosion, are among the main tourist attractions. In Puerto Rico, critical infrastructure (for example, drinking water pipelines and pump stations, sanitary pipelines and pump stations, wastewater treatment plants, and power plants) is vulnerable to the effects of sea level rise, storm surge, and flooding. In the USVI, infrastructure and historical buildings in the inundation zone for sea level rise include the power plants on both St. Thomas and St. Croix; schools; housing communities; the towns of Charlotte Amalie, Christiansted, and Frederiksted; and pipelines for water and sewage.

Climate change will likely result in water shortages due to an overall decrease in annual rainfall, a reduction in ecosystem services, and increased risks for agriculture, human health, wildlife, and socioeconomic development in the U.S. Caribbean. These shortages would result from some locations within the Caribbean experiencing longer dry seasons and shorter, but wetter, wet seasons in the future. [2,3,4,5,6,7,8] Extended dry seasons are projected to increase fire likelihood.[9,10] Excessive rainfall, coupled with poor construction practices, unpaved roads, and steep slopes, can exacerbate erosion rates and have adverse effects on reservoir capacity, water quality, and nearshore marine habitats.

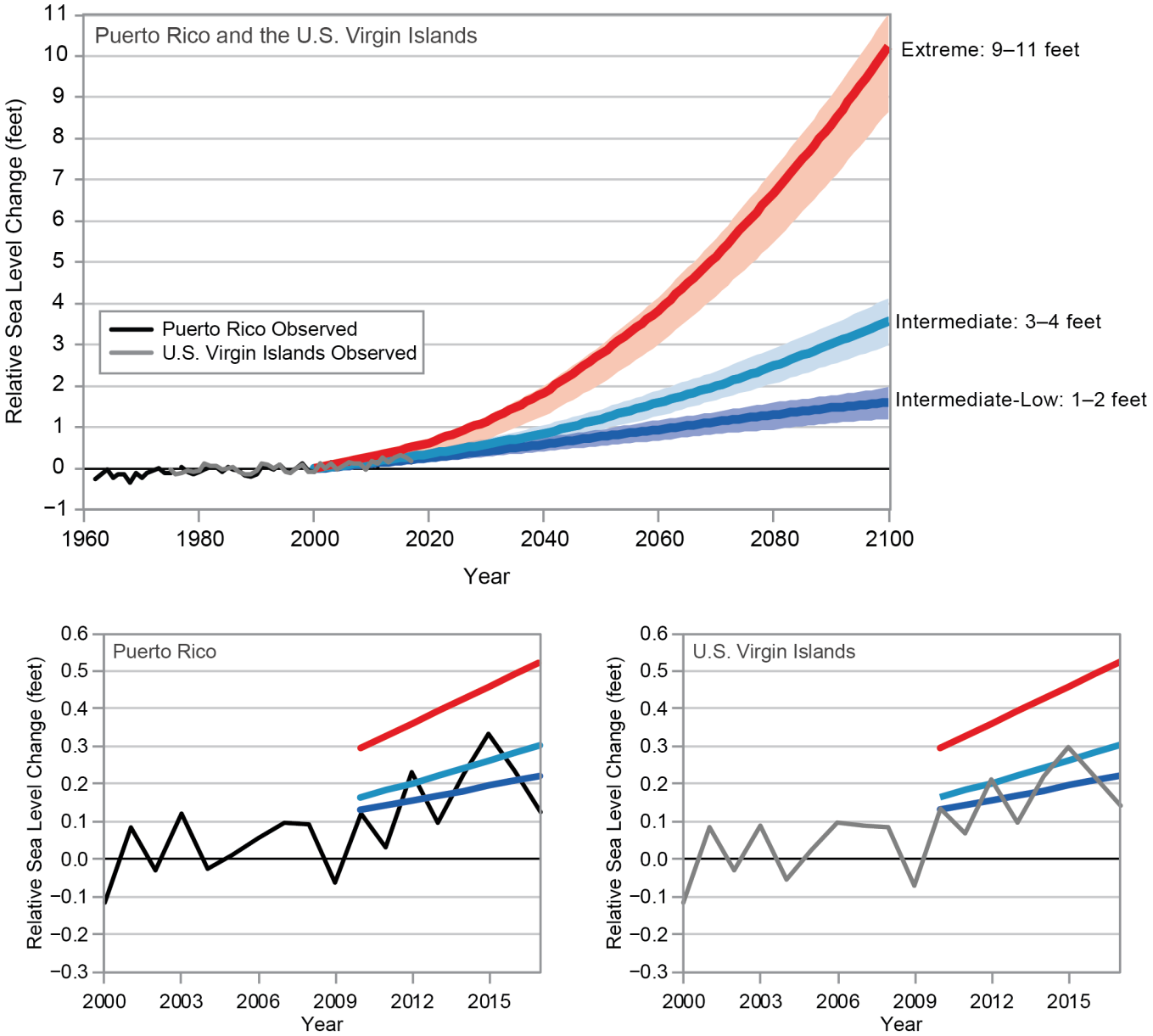
Ocean warming poses a significant threat to the survival of corals and will likely also cause shifts in associated habitats that compose the coral reef ecosystem. Severe, repeated, or prolonged periods of high temperatures leading to extended coral bleaching can result in colony death. Ocean acidification also is likely to diminish the structural integrity of coral habitats. Studies show that major shifts in fisheries distribution and changes to the structure and composition of marine habitats adversely affect food security, shoreline protection, and economies throughout the Caribbean.

In Puerto Rico, the annual number of days with temperatures above 90°F has increased over the last four and a half decades. During that period, stroke and cardiovascular disease, which are influenced by such elevated temperatures,

became the primary causes of death.[11,12] Increases in average temperature and in extreme heat events will likely have detrimental effects on agricultural operations throughout the U.S. Caribbean region.[13,14] Many farmers in the tropics, including the U.S. Caribbean, are considered small-holding, limited resource farmers and often lack the resources and/or capital to adapt to changing conditions. [15]

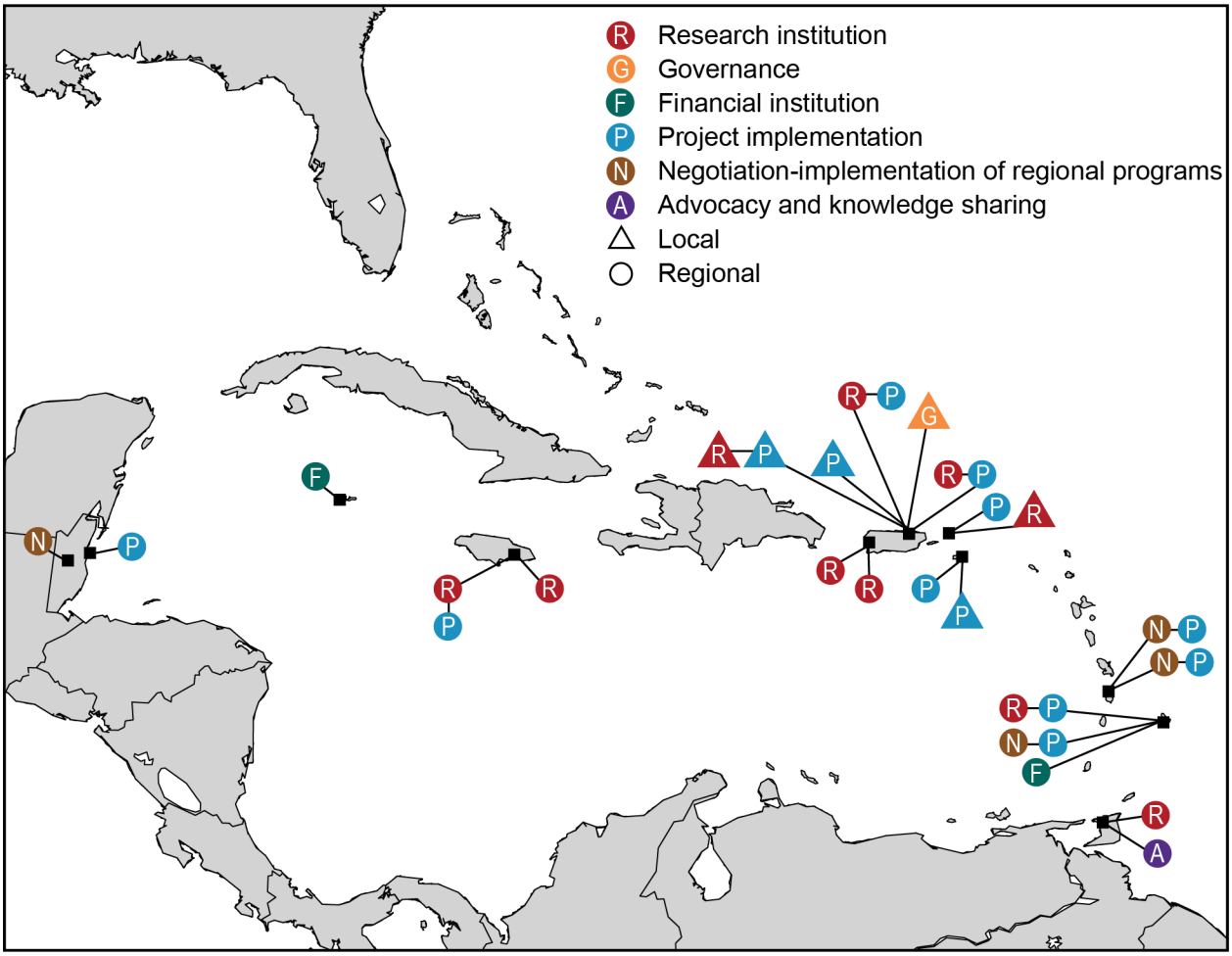
Most Caribbean countries and territories share the need to assess risks, enable actions across scales, and assess changes in ecosystems to inform decision-making on habitat protection under a changing climate.[16,17] U.S. Caribbean islands have the potential to improve adaptation and mitigation actions by fostering stronger collaborations with Caribbean initiatives on climate change and disaster risk reduction.

Observed and Projected Sea Level Rise



(top) Observed sea level rise trends in Puerto Rico and the U.S. Virgin Islands reflect an increase in sea level of about 0.08 inches (2.0 mm) per year for the period 1962–2017 for Puerto Rico and for 1975–2017 for the U.S. Virgin Islands. The bottom panels show a closer look at more recent trends from 2000 to 2017 that measure a rise in sea level of about 0.24 inches (6.0 mm) per year. Projections of sea level rise are shown under three different scenarios of Intermediate-Low (1–2 feet), Intermediate (3–4 feet), and Extreme (9–11 feet) sea level rise. The scenarios depict the range of future sea level rise based on factors such as global greenhouse gas emissions and the loss of glaciers and ice sheets. *From Figure 20.6. (Sources: NOAA NCEI and CICS-NC).*

Climate Risk Management Organizations



Some of the organizations working on climate risk assessment and management in the Caribbean are shown. Joint regional efforts to address climate challenges include the implementation of adaptation measures to reduce natural, social, and economic vulnerabilities, as well as actions to reduce greenhouse gas emissions. See the online version of this figure at http://nca2018.globalchange.gov/chapter/20#fig-20-18 for more details. *From Figure 20.18 (Sources: NOAA and the USDA Caribbean Climate Hub)*.