

# WATER FACTS

## Miami and the Keys, Florida: Identifying and Becoming More Resilient to Impacts of Climate Change



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Cities across the United States should anticipate significant water-related vulnerabilities based on current carbon emission trends because of climate change, ranging from water shortages to more intense storms and floods to sea level rise. To help cities become more resilient to the rising threats of climate change, NRDC reviewed more than 75 scientific studies and other reports to summarize the water-related vulnerabilities in 12 cities—including Miami and the Keys. Although there may still be some uncertainty about what particular impacts threaten cities and how quickly or severely they might occur, action at the local level is the most effective method of reducing, mitigating, and preventing the negative effects of water-related climate change outlined in this fact sheet. NRDC urges cities to prepare for coming challenges relating to water resources. Fortunately, there are steps cities are already taking to become more resilient.

As one of America’s most heavily visited tourist destinations, the city of Miami benefits from its many beaches. However, its coastal proximity also puts it at increased risk due to climate change. Based on current climate research, we know that Miami and the Keys are vulnerable to:

Summary of water-related climate changes and impacts in Miami and the Florida Keys throughout the 21st century	
	Rising sea levels
	Increased flooding
	Increased saltwater intrusion
	More frequent and intense storm events
	Increased erosion
	Water supply challenges due to increased droughts
	Increased impacts to fisheries
	Decreased annual precipitation

● Highly likely    
 ● Likely    
 ● Possible

Source: NRDC



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## SEA LEVEL RISE AND SALTWATER INTRUSION

The projected sea level rise for Miami, at current rates of global warming, is 1.5 to 2.3 feet (0.5 to 0.7 meters) by mid-century and 3 to 5 feet (0.9 to 1.5 meters) by 2100. Given that the average elevation of land in Miami is 6 feet (1.8 meters) above mean high water, Miami is highly vulnerable to the effects of global sea level rise. Infrastructure in highly-developed areas that are at risk include power plants, power generating facilities, airports, solid waste disposal sites, schools, prisons, and hospitals.

Sea level rise threatens Miami's main drinking water source, the Biscayne Aquifer. Sea level rise is also expected to cause saltwater intrusion further into Miami's estuaries, coastal wetlands, and tidal rivers, as well as its groundwater aquifers. Sea level rise could also leave many of Miami's sandy beaches, and parts of the nearby Everglades, including the sensitive habitats that depend on that ecosystem, underwater by mid-century. These impacts would cause Miami's tourism economy to suffer.

## STORM EVENTS AND COASTAL AND INLAND FLOODING

Annual rainfall in southeast Florida is likely to decrease by 10 to 20 percent in the coming decades. While the frequency of storms in Miami may decrease on an annual basis, storms that do occur, including tropical storms and hurricanes, may be more intense, putting Miami at a high risk for flooding from storm surges, especially in combination with sea level rise. According to research by the Organization of Economic Cooperation and Development (OECD), at present day conditions, Miami ranks number one worldwide in terms of assets exposed to coastal flooding and fourth in terms of population exposed (after Mumbai, Guangzhou, and Shanghai). Further, sea level rise will reduce the capacity of Miami's porous limestone substrate to absorb stormwater, increasing inland flooding.

## BEACH EROSION

Beach erosion that results from rough seas during hurricanes, storms, and periods of high wind, and that is exacerbated by rising sea levels, will likely increase. Wide beaches also have significant benefits for storm damage reduction. To counter the impacts of beach erosion, sand renourishment may have to occur more frequently. However, this labor-intensive process comes with a price.

## INCREASED TEMPERATURE AND DROUGHT

Temperatures in Miami are expected to increase between 4.5 and 9°F (2.5 to 5°C) by mid-century. Moreover, heat waves are expected to increase in duration and number with temperatures above 90°F more than two-thirds of the year. These hotter temperatures combined with less annual rainfall could bring longer droughts to south Florida. Hotter and drier conditions, summertime heat waves that increase evapotranspiration and reduce soil moisture content and groundwater levels, and a projected increase in Florida's population will decrease supply and increase demand for water.

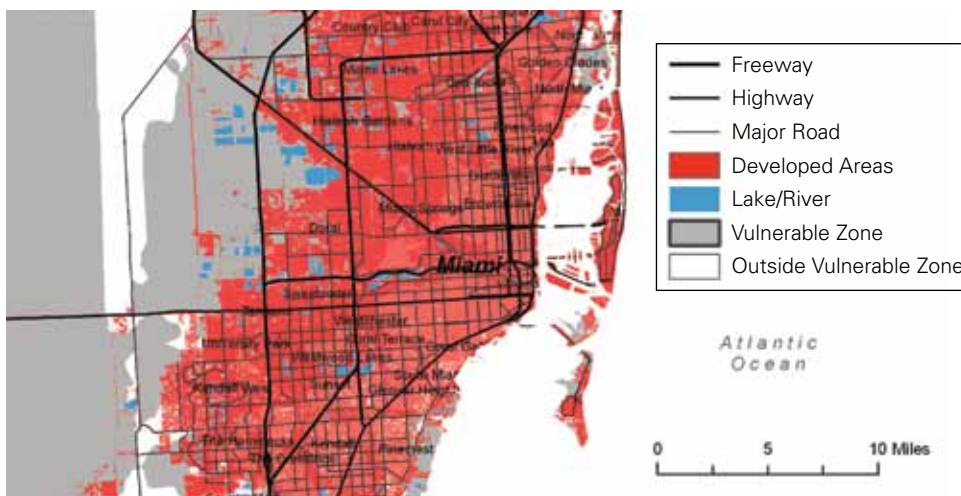
## ACTIONS

Recognizing some of the serious predictions for its region, the city of Miami and Miami-Dade County are investing many resources into planning for climate change impacts. In the city's "MiPlan," the city proposes efforts such as incorporating climate change into long-term planning, including the likely impacts of sea level rise on current and future infrastructure, flood mitigation, water supply risk, and health impacts of increased temperatures, and increasing water management efforts including water conservation, pollution prevention, and water resource planning.

An important component of the county's planning efforts is the Southeast Florida Regional Climate Change Compact. Miami-Dade, Broward, Palm Beach, and Monroe Counties are working together in order to coordinate policy positions, scientific research, and mitigation and adaptation efforts. Miami-Dade County and the region are also leveraging their resources to enlist the assistance of federal agencies, such as the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the National Park Service (Miami is flanked by two national parks), and the Army Corps of Engineers.

In the Florida Keys, important efforts to become more resilient include the Florida Reef Resilience Program's climate action plan for 2010–15 for the Florida Keys National Marine Sanctuary.

Miami's zone of vulnerability to a 0.7-meter sea level rise



Source: Stanton EA, Ackerman F, Florida and Climate Change: The Costs of Inaction, Tufts University (2007).

## THE FLORIDA KEYS

Sea level rise threatens the very existence of the Florida Keys, owing to their low elevation (an average of 4 to 7 feet, or 1.2 to 2.1 meters, above current sea level) and their high water-to-land ratio (any point on land is within 4 miles of water). Estimates of the potential loss of land area in the Keys range from 38 percent (at a value of \$11 billion) to 92 percent (\$35 billion). More severe storms and hurricanes will exacerbate the impact of rising sea levels on shorelines as well as on mangroves and sea grasses. Higher water temperatures and ocean acidification threaten the viability of the only living coral reef ecosystem in the continental United States. Depending on the climate change scenario, between half and all of the coral cover is likely to be completely wiped out in the Keys. Either of these scenarios would have devastating impacts.



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Ocean acidification threatens coral reef ecosystems