



SEA-LEVEL RISE AND ITS IMPACT ON MIAMI-DADE COUNTY

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SEA-LEVEL RISE AND THE INFLUENCE OF CLIMATE CHANGE

- *It is well-established that climate change has resulted in global sea-level rise.¹*
- *The two most significant factors contributing to sea-level rise over the last 20 years have been warming ocean water (39 percent) and freshwater input from melting ice sheets, ice caps, and glaciers (49 percent):²*
- *Since 1870, average global sea level has risen by about 8 inches.³*
 - *In Southeast Florida, sea level has risen 12 inches.⁴*
- *As the climate has become increasingly warmer, the annual rate of sea-level rise has accelerated.⁵*
- *Average annual sea-level rise between 1993 and 2010 was almost twice the rate from 1901-2010.⁶*
- *By the year 2060, it is estimated that sea levels along Florida's coastline could rise between another 9 inches to 2 feet.⁷*

LOCAL IMPACTS OF SEA-LEVEL RISE AND EXTREME WEATHER EVENTS

- *In Miami Beach, sea-level rise has made prolonged flooding a frequent event after strong storms, particularly in low-elevation neighborhoods. This has led city officials to consider a **\$206 million** renovation of their drainage system.⁸*
- *Damages caused by Hurricane Sandy and storms over Thanksgiving weekend in 2012 resulted in the Florida Department of Transportation spending **\$8.3 million** on a project to repair a section of Highway A1A in Fort Lauderdale.⁹*
- *While the center of Hurricane Sandy remained roughly 200 miles offshore from Florida's coast, it still caused moderate to major beach erosion from central Florida southward to Miami-Dade County.¹⁰*
- *Sea-level rise will threaten the sustainability of the county's beaches by increasing the likelihood of beach erosion.¹¹*
- *A recent study by the Army Corps of Engineers found that Miami-Dade will need roughly 23 million cubic yards of beach renourishment (or the equivalent of more than **10,781 football fields** covered in 1 foot of sand) over the next 50 years to sustain its beaches. The county has used up nearly the entirety of its available domestic sand sources just offshore, and will need to find acceptable alternative sources for future beach renourishment.¹²*
 - Sand that is dependable, economical, and environmentally practicable in Miami-Dade County is "nearly depleted," according to Amanda Ellison, Public Affairs Specialist at U.S. Army Corps of Engineers.¹³
- *Projected erosion rates for some of the beaches in Miami-Dade are:¹⁴*
 - Miami Beach: 100,000 cubic yards/year (or the equivalent of more than **46 football fields** covered by 1 foot of sand per year)
 - Sunny Isles: 50,000 cubic yards/year (or the equivalent of more than **23 football fields** covered by 1 foot of sand per year)
 - Surfside: 45,000 cubic yards/year (or the equivalent of more than **21 football fields** covered by 1 foot of sand per year)
 - Haulover Park: 30,000 cubic yards/year (or the equivalent of more than **14 football fields** covered by 1 foot of sand per year)
 - Bal Harbour: 30,000 cubic yards/year (or the equivalent of more than **14 football fields** covered by 1 foot of sand per year)
- *According to estimates in Miami-Dade County's FY 2013-2014 Proposed Budget and Multi-Year Capital Plan, the county will need to spend more than **\$32 million** for beach erosion and renourishment between 2013 and 2017.¹⁵*
- *According to the Florida Department of Environmental Protection:¹⁶*
 - Most of Dade County's barrier island coast north of Cape Florida is critically eroded.
 - The northern 5.1 miles of Dade County (R1-R26.7) has **critical** erosion threatening development along Golden Beach and Sunny Isles and recreational interests at Haulover Beach Park.
 - Between Bakers Haulover Inlet and Government Cut (R27-R74.4) are 9.4 miles of **critical** erosion, which threatens development and recreational interests along Bal Harbour, Surfside, and Miami Beach.
 - The northern end of Key Biscayne (R89-R92) has 0.6 miles of noncritical erosion, and the southern half of Key Biscayne (R101-R113) has 2.5 miles of critical erosion. The **critically** eroded area threatens development in the Village of Key Biscayne and recreational interests at Bill Baggs Cape Florida State Park.

- *Eight hurricanes directly impacted Miami-Dade between 2004 and 2005 and caused over **\$3 billion** in damages within the county alone:¹⁷*

YEAR	HURRICANE	DAMAGE COSTS (MILLIONS) ^a
2004	Charley	\$3.48
2004	Frances	\$81.50
2004	Ivan	\$3.32
2004	Jeanne	\$18.73
2005	Dennis	\$6.91
2005	Katrina	\$675.39
2005	Rita	\$5.09
2005	Wilma	\$2,210.00

- *The 7-foot-high storm surge in Miami-Dade County from Hurricane Wilma has a likelihood of happening once every 76 years, **but...**^{b, 18}*

- If sea level along Miami-Dade's coast rises by just over another **foot**, the same 7-foot storm surge would have a likelihood of occurring once every **21 years**.
- If sea level along Miami-Dade's coast rises slightly above **2 feet**, the same 7-foot storm surge would have a likelihood of occurring once every **5 years**.

- *As a result of sea-level rise, flooding from just high tide events is becoming more common and has even caused the National Weather Service to issue a coastal flood warning from a 2013 high tide event in Miami-Dade.¹⁹*

LOCAL VULNERABILITIES TO SEA-LEVEL RISE

- *Florida is the **most vulnerable** state to sea-level rise in the United States,²⁰ and Miami has the largest amount of exposed assets and the **fourth-largest** population vulnerable to sea-level rise in the world.²¹*
- *Miami-Dade's estimated beachfront property value is more than **\$14.7 billion**, not including infrastructure.^{c, 22}*

a Adjusted for inflation.

b As of 2008.

c Adjusted for inflation.

- *Tourism is Florida's number one industry, and Miami accounted for \$21.8 billion of the \$71.8 billion (more than **30 percent**) spent by visitors in 2012 statewide.^{23, 24}*
- *Miami-Dade alone has more people living less than 4 feet above sea level than **any state in the nation** except Louisiana.²⁵*
- *The porous limestone underlying much of Florida makes the state particularly vulnerable to sea-level rise. Seawalls can't block seawater from infiltrating underground, and saltwater from the ocean is already contaminating freshwater aquifers.²⁶*
- *According to a recent study by Florida Atlantic University:*

Up to 70% of the drainage capacity of the 28 coastal flood/salinity control structures protecting Southeast Florida from flooding and saltwater intrusion could be lost with sea level rise of only 3 to 9 inches, anticipated by about 2030 to 2050. Adaptation may require the addition of high-capacity pumping stations costing approximately \$70 million each (plus necessary land acquisitions). Three pumping stations costing a total of over \$200 million (plus land) could be needed in north Miami-Dade County in the near future.²⁷

- *According to a recent study by Dr. Keqi Zhang, Professor in the Department of Earth and Environment at Florida International University:²⁸*

More than 10 percent of land in Miami-Dade sits at less than 1 foot above current sea level, nearly 20 percent at less than 2 feet, and one-fourth at less than three feet.

- *In Miami-Dade County, the following are located less than one, two, and three feet above the current sea level:²⁹*

Property Value

Below 3 feet: \$38.01 billion
 Below 2 feet: \$16.33 billion
 Below 1 foot: \$7.32 billion

Homes

Below 3 feet: 71,702
 Below 2 feet: 25,192
 Below 1 foot: 8,512

Roads

Below 3 feet: 384 miles
 Below 2 feet: 134 miles
 Below 1 foot: 25 miles

Hazardous Waste Sites

Below 3 feet: 73
 Below 2 feet: 23
 Below 1 foot: 8

Wastewater Sites

Below 3 feet: 73
 Below 2 feet: 36
 Below 1 foot: 11

Population

Below 3 Feet
 Total: 128,548
 Caucasian: 104,265
 Hispanic: 74,002
 African American: 17,354
 Asian: 3,057
 Native American: 995

Below 2 Feet

Total: 47,351
 Caucasian: 38,132
 Hispanic: 27,136
 African American: 6,753
 Asian: 1,247
 Native American: 343

Below 1 Foot

Total: 19,077
 Caucasian: 14,534
 Hispanic: 11,333
 African American: 3,603
 Asian: 500
 Native American: 120

LOCAL LEADERS RESPONDING, ACTION PLANS, AND RESOURCES

While being located at the frontlines of sea-level rise has presented Miami-Dade with daunting challenges, the leadership and action being taken by local officials, governments, universities, and organizations have laid a foundation of planning, policy, and awareness that can be built upon to help ensure a sustainable future.

Local Officials Taking a Stand on Climate Change and Sea-Level Rise:

- *Signatories of the Resilient Communities for America Agreement – a pledge to create more resilient cities, towns, and counties to challenges like climate change:*
 - City Commissioner Enbar Cohen (Aventura, FL)
 - Mayor Daniel E. Dietch (Surfside, FL)
 - Council Member Ivonne Ledesma (Miami Shores, FL)
 - Mayor Cindy Lerner (Pinecrest, FL)
 - Clerk of the Courts Harvey Ruvin (Miami-Dade County, FL)

PLANS AND RESOURCES:

The following organizations, partnerships, and plans offer additional information on action being taken at the local, regional, and state level to address climate change.

- *Climate Leadership Engagement Opportunities (CLEO) Institute:*³⁰

The CLEO Institute recognizes climate change as THE defining environmental issue of modern times. CLEO's goal is to bridge the divide between science and society on the urgent issue of climate change. CLEO is working to create an informed and engaged public, one that is better willing to make personal changes and support climate resilience efforts locally, regionally, nationally, and globally. CLEO establishes numerous access points for the public to participate in initiatives that help them better understand the science of climate change, the dangers and significant disruptions that climate change imposes, and promising efforts and solutions. Through varied activities, events, and trainings, CLEO encourages combinations of structured, interactive, open-ended, and social learning opportunities.

- *Florida Center for Environmental Studies:*³¹

The Florida Center for Environmental Studies (CES) is a state university research center that was established in July 1994 by Florida's State University System's Board of Regents. CES' environmental research and education efforts focus on the Kissimmee River Restoration Project and the Comprehensive Everglades Restoration Plan (CERP), the largest river and ecosystem restorations in the world. Since 2006, CES has focused on impacts of climate change on the infrastructure and ecosystems of Florida. In 2009, climate change research was designated as a Florida Atlantic University (FAU) research priority. CES manages the interdisciplinary Climate Change Initiative research within the FAU. CES is now one of the leading organizations in Florida, coordinating climate change research and education efforts that help facilitate productive environmental research, information, and training opportunities at FAU, other Florida universities, and state, national, and international agencies.

- *Florida Climate Institute:*³²

The Florida Climate Institute (FCI) is a multi-disciplinary network of national and international research and public organizations, scientists, and individuals concerned with achieving a better understanding of climate variability and change. The FCI has seven member universities – Florida Atlantic University (FAU); Florida International University (FIU); Florida State University (FSU); the University of Central Florida (UCF); the University of Florida (UF); the University of Miami (UM); and the University of South Florida (USF) – and is supported by relevant colleges, centers, and programs at these universities.

- *Florida Division of Disease Control and Health Protection: Building Resilience Against Climate Effects (BRACE):*³³

The Building Resilience Against Climate Effects (BRACE) Program at the Florida Department of Health (FDOH) is working to improve the ability of the public health sector to respond to health effects related to climate variability. This will be done by incorporating the best available climate science into routine public health practice. In order to achieve this goal, the BRACE Program is analyzing the current and projected future impacts of climate on health. The program will be developing a Florida climate and health adaptation plan.

- *Florida Water & Climate Alliance:*³⁴

The Florida Water and Climate Alliance is a stakeholder-scientist partnership committed to increasing the relevance of climate science data and tools at relevant time and space scales to support decision-making in water resource management, planning, and supply operations in Florida.

- *GreenPrint:*³⁵

A sustainability plan that outlines 137 initiatives that build a roadmap for Miami-Dade County to achieve its goal of reducing its greenhouse gases by 80 percent from 2008 levels by 2050.

The plan was developed from a collaborative process among the many diverse stakeholders that involved county staff, community groups, experts from the business community and academia, and a wide range of individual Miami-Dade residents.

■ *Green Corridor (PACE):*³⁶

Property Assessed Clean Energy (PACE) is a financing program designed to help qualifying homeowners invest in specified energy-efficiency and renewable energy improvements. The Village of Pinecrest has partnered with neighboring municipalities to establish a PACE district – the first such district in the State of Florida.

■ *Miami's Climate Action Plan:*³⁷

Miami-Dade County's Climate Action Plan is an integral component of GreenPrint. This initial plan focuses on what steps will be necessary in the next five years to further reduce greenhouse gas emissions, as well as better determine the potential impacts and resulting vulnerabilities of climate change in the region and the community. These steps will make Miami-Dade County a more resilient community in the face of a changing climate. Two goals of the Climate Action Plan are: 1) Understand and respond to current and future climate change impacts, and 2) Reduce greenhouse gas emissions 10 percent from 2008 levels by 2015 and 80 percent by 2050.

■ *Southeast Florida Regional Climate Action Plan:*³⁸

The Regional Climate Action Plan calls for concerted action in reducing greenhouse gas emissions and adapting to regional and local impacts of a changing climate. The recommendations presented in the plan aim to accomplish these goals while also serving to protect the assets of the region's unique quality of life and economy, guiding future investments, and fostering livable, sustainable, and resilient communities. The specific recommendations put forth in the plan were developed through a collaborative process involving nearly 100 subject-matter experts from a host of professions representing the public and private sectors, area universities, and not-for-profit organizations.

■ *Southeast Florida Regional Climate Change Compact:*³⁹

Four county governments in Southeast Florida, in response to impacts of sea-level rise, established the Southeast Florida Regional Climate Change Compact in January 2010. The purpose of this agreement between the county governments of Broward, Miami-Dade, Monroe, and Palm Beach Counties – which have a combined population of 5.6 million – is to develop mitigation and adaptation strategies through joint efforts and to actively inform critical policymaking and government funding decisions at the state and federal levels.

■ *Southeast Florida Regional Partnership:*⁴⁰

The Southeast Florida Regional Partnership (SFRP) is a voluntary, broad-based, and growing collaboration of more than 200 public, private, and civic stakeholders from the Southeast Florida region of Monroe, Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, and Indian River counties. The Partnership has united to leverage resources and coordinate strategic long-term planning to drive competitiveness and prosperity for the region. SFRP seeks greater opportunities for sustained job creation, access to affordable housing, a better menu of transportation options, and more people-friendly, environment-friendly places to live.

ENDNOTES

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ABOUT WRI

WRI is a global research organization that works closely with leaders to turn big ideas into action to sustain a healthy environment—the foundation of economic opportunity and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.



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