

VAN
ALEN
INSTITUTE

KEEPING CURRENT RESOURCE GUIDE



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Keeping Current: A Sea Level Rise Challenge for Greater Miami
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INTRODUCTION

"TO PLAN FOR CLIMATE CHANGE IN SOUTH FLORIDA, WE CAN EITHER EASE THE SYMPTOMS OR WE CAN TAKE A HOLISTIC APPROACH THAT BUILDS THE MATERIAL AND SOCIAL ADAPTIVE CAPACITY FOR OUR COLLECTIVE FUTURE. A CRITICAL FIRST STEP IS SYNCING PUBLIC AND PRIVATE ACTORS WHO NOT ONLY DIAGNOSE THE PROBLEMS BUT UTILIZE DESIGN TO ADDRESS A RANGE OF CONTEXTUAL ISSUES FROM THE USES OF PUBLIC SPACE TO ACCESSIBILITY."

— Jesse Keenan, Harvard University Graduate School of Design, Faculty of Architecture



Photo: Phillip Pessar, Flickr

INTRODUCTION

South Florida has become emblematic of the threats of climate change, and due to its unique geographical conditions, the region needs to adapt in ways never seen before. With billions of dollars being invested in water infrastructure improvements and in new development in the coming decade, there will be many opportunities for architects, engineers, scientists, government officials, and the public to make South Florida a global model for climate change adaptation. New developments must be designed to enable communities to live with water.

In 2017, [Van Alen Institute](#) launched [Keeping Current: A Sea Level Rise Challenge for Greater Miami](#), a series of open design competitions inviting interdisciplinary teams to develop solutions and ideas using the lenses of economy, ecology, and equity to adapt to climate change. These solutions must respond to the following three criteria:

1. Replicable across South Florida
2. Responsive to the interrelated economic, ecological, and equity impacts of climate change
3. Aligned with the resilience strategy developed through the process established by [100 Resilient Cities—Pioneered by the Rockefeller Foundation](#)

Keeping Current turns the design competition model on its head by identifying infrastructure projects that are already in the pipeline and in urgent need of solutions to address sea level rise. Design competitions will produce design solutions to be implemented

by municipal partners in South Florida. This method ensures that existing municipal resources are being leveraged for adaptation and that winning designs can transition smoothly to construction.

The first design competition will focus on a masterplan for Jose Marti Park in Miami, located along the Miami River in Little Havana. The brief for that competition will be released by the City of Miami in 2018. The second is slated for 2019.

Keeping Current will develop tailored community engagement efforts to ensure residents are involved in the process from the start. This inclusive process will connect selected design teams and municipal stakeholders with community members to incorporate local knowledge, feedback, and interests into the designs. *Keeping Current* will also host an ideas challenge for high school students in Miami-Dade County that will engage and cultivate the next generation of leaders, equipping them with a deeper understanding of climate change issues and design skills that can be applied to identify solutions.

This *Keeping Current Resource Guide* is intended for design teams applying to the project's competitions or working on future infrastructure projects in the region—in particular, teams unfamiliar with the South Florida region. The guide shares information on local approaches to climate change adaptation and gathers reports, articles, online mapping tools, and other information that can inform teams' work. The guide is intended to offer a user-friendly survey of resources for exploration and understanding of the region.

ABOUT

ABOUT THIS GUIDE



Keeping Current Research Summit 2017

Photo: Monica McGivern

HOW DID WE CREATE THIS GUIDE?

- To launch our two-year program, *Keeping Current: A Sea Level Rise Challenge for Greater Miami*, Van Alen Institute organized a one-day research summit in November 2017 in Miami, engaging more than 30 scientists, researchers, designers, and other experts to identify promising approaches to key challenges in the region, as well as future research, resources, and policies that are needed for the region to adapt to climate change in ways that promote ecology, economy, and equity.
- We reviewed dozens of articles, books, reports, and other sources to compile key priorities, initiatives, and potential solutions and approaches to climate change adaptation in the region. We pulled information from the Southeast Florida Regional Climate Change Compacts' [Regional Climate Action Plan](#).
- We interviewed 12 experts in South Florida, New Orleans, New York, and Rotterdam to provide more detail on specific challenges and case studies.
- We developed the final draft in collaboration with university experts, municipal chief resilience officers, and project advisors.

ECONOMY ECOLOGY EQUITY

Stakeholders addressing the challenges of climate change face a daunting, overriding question: How should we prioritize our investments for the region's future based on the limited resources and information we have today? Through our climate change adaptation work, we've found that it's critical to think about plans and investment using the lenses of economy, ecology, and equity. This means prioritizing the following goals for adaptation initiatives:

Ecology

- Develop strategies to address the current and future impacts of sea level rise.
- Integrate ecological and built systems.
- Protect, strengthen, and support public access to and awareness of ecological systems.

Economy

- Support the region's main industries and diversify the region's economy.
- Promote the creation of jobs, training, and educational programs that prepare people for a changing workforce.
- Connect more communities to economic opportunity and good jobs.

Equity

- Create physical places that are inclusive and welcoming to everyone.
- Prioritize vulnerable communities (for instance, low-lying or low-income) for adaptation investments.
- Engage diverse stakeholders and ensure that existing residents have a sense of ownership over climate adaptation initiatives in their community.

"BECAUSE OF SOUTH FLORIDA'S UNIQUE GEOLOGY, HYDROLOGY, AND TOPOGRAPHY, WE CAN'T SIMPLY PLAN TO ACCOMMODATE THE LARGEST POSSIBLE POPULATION OVER THE LONGEST POSSIBLE TIME SPAN. IMPLEMENTING EVEN THE MOST INNOVATIVE SHORT-TERM ADAPTATION STRATEGIES ISN'T ENOUGH. INSTEAD, RECOGNIZING THE MAGNITUDE OF THE REGION'S VULNERABILITIES AND THE EXPOSURE OF OUR COMMUNITIES, WE URGENTLY NEED TO PLAN FOR A RADICALLY DIFFERENT LONG-RANGE FUTURE FOR THE REGION."

— Joanna Lombard, Professor, School of Architecture and Department of Public Health Sciences, University of Miami

GUIDING PRINCIPLES

The research summit brought experts from many disciplines to discuss a wide range of challenges facing the region. Across breakout groups and themes, participants returned to a few guiding principles that should inform strategies and ideas for climate change adaptation in the South Florida region.



The Miami River

Photo: Kaserei, Pixabay

There's Only One South Florida

South Florida has unique conditions that make climate change adaptation particularly challenging. Solutions can't just be imported from elsewhere. They must be modified, or new ones must be invented.

Connect the Dots

The impacts of climate change—already felt in the air, sea, and water in South Florida—will require the region's stakeholders to work across municipal boundaries, agency silos, and disciplines to develop solutions that address multiple challenges at once.

Change the Rules

Like South Florida's infrastructure, the region's regulations were largely developed for the priorities of a past era, not for climate change adaptation. To unlock what design can do, designers need to learn from and work with policy and legal experts to help update regulations and practices.

Know your Priorities

Planning for sea level rise requires informed and transparent decision-making that weighs costs and benefits over time for the diverse communities of the region. But it's critical to prioritize some outcomes—for instance, equitable distribution of resources and protection of ecological functions—to guide decision-making.

Develop Community Agency

To empower people to make informed choices about their futures and to build political support for climate change adaptation, it's essential that designers and other stakeholders engage the public when developing and implementing adaptation strategies. Every infrastructure improvement or policy change is an opportunity to explain to residents, business owners, and others: Why are we making this choice? How does it work? What benefits does it bring?

"THE RESOURCE GUIDE PULLS TOGETHER BEST PRACTICES AND RECOMMENDATIONS FOR HOW TO PLAN, DESIGN, BUILD, AND MAINTAIN SAFER BUILDINGS, INFRASTRUCTURE, AND LANDSCAPES TO BETTER SERVE EVERYONE LIVING IN OUR COASTAL COMMUNITIES."

— Jane Gilbert, Chief Resilience Officer,
Office of Resilience and Sustainability, City of
Miami

WHAT'S IN THE GUIDE?

Designing to Live with Water

The four topics in this section—water management, natural resources, transportation, and planning and development—were selected based on feedback from research summit participants about priorities, opportunities, and challenges for the region.

Each topic includes:

- An overview: The overview offers a short statement about challenges and a few at-a-glance data points.
- Key themes: Like the guiding principles for the project as a whole, key themes offer important insights for teams tackling that particular topic.

Case Studies

This section examines two projects that offer important adaptation lessons for South Florida in adapting to climate change and highlights innovative multidisciplinary design strategies and design engagement processes.

Resources

This section provides links to key stakeholder websites, studies, online tools, publications, and other information.

ORGANIZER AND CONTRIBUTORS

Van Alen Institute

At Van Alen Institute, we believe design can transform cities, landscapes, and regions to improve people's lives. We collaborate with communities, scholars, policymakers, and professionals on local and global initiatives that rigorously investigate the most pressing social, cultural, and ecological challenges of tomorrow. Building on more than a century of experience, we develop cross-disciplinary research, provocative public programs, and inventive design competitions.



Port of Miami

Photo: Harshil Shah, Flickr

In recent years, our competitions have ranged from temporary installations that activate public spaces to large-scale, multi-year initiatives addressing climate change. For each project, we lead designers and experts from many disciplines in collaboration with key stakeholders—including government officials, business leaders, and members of the general public—to produce visionary ideas and implementable solutions.

Keeping Current is spearheaded by Van Alen Institute and is part of our broader inquiry into how communities are impacted by climate change and how community engagement practices can be redefined. This research is also explored in such initiatives as *Shore to Core*, a design and research competition to reimagine downtown West Palm Beach as a dynamic, resilient waterfront city; *Crossroads Conversations*, a public program that invites passersby from all walks of life and political convictions to engage in thoughtful dialogue on some of the most pressing issues of our time in iconic public spaces; and *Rebuild by Design*, an initiative of President Obama's Hurricane Sandy Rebuilding Task Force and the U.S. Department of Housing and Urban Development (HUD) to address the structural and environmental vulnerabilities that Hurricane Sandy exposed in communities throughout the region and develop fundable solutions to better protect residents from future climate events.

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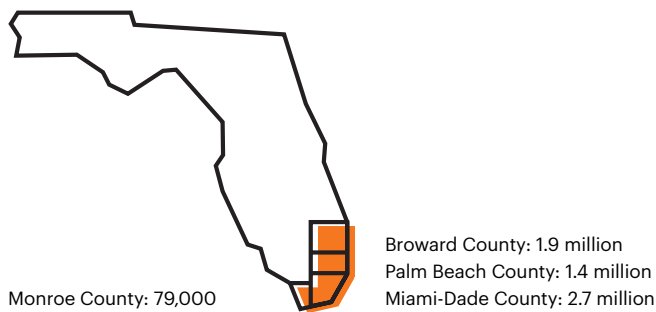
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REGIONAL SNAPSHOT

While municipal boundaries are defined on maps and in legal documents, regional borders are not quite as clear-cut. For the purposes of this guide, we refer to South Florida using the same boundaries as the Southeast Florida Regional Compact: four counties (Broward, Miami-Dade, Monroe, Palm Beach) and 35 local governments, encompassing 1,946 square miles.

POPULATION (2016 CENSUS)



ANNUAL GROSS DOMESTIC PRODUCT

Roughly 2.5 billion
(roughly 30% of statewide economic output)

TOP PRIVATE EMPLOYERS



University of Miami
12,818



Baptist Health South Florida
11,353



American Airlines
11,031



Nova Southern University
7,462



Tenet Healthcare Corporation
4,595



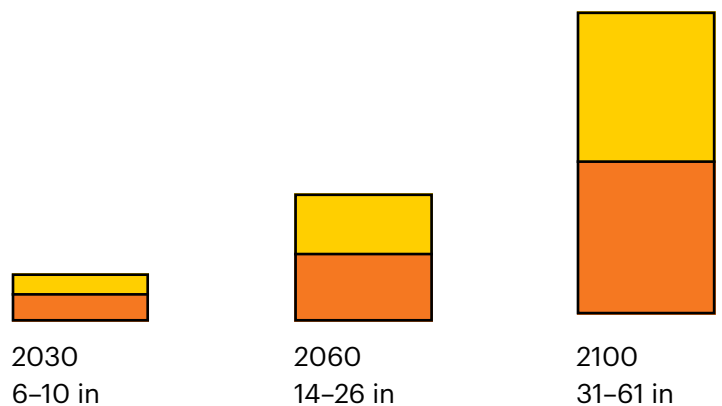
NextEra Energy, Inc.
4,005



AutoNation
4,000

However, data about the region often focuses on a specific city or county, or other definition the region. (For instance, “Greater Miami” refers to Miami-Dade County, the City of Miami, and the City of Miami Beach.) In these cases, we will always identify the specific geography to which data or analysis refers.

SEA LEVEL RISE PROJECTIONS (ABOVE THE 1992 MEAN SEA LEVEL):



TRANSPORTATION



6 airports



3 ports



Metrorail (heavy rail)
Brightline commuter rail
Amtrak passenger rail
Florida East Coast rail
Tri-Rail commuter rail



Metrobus



Metromover
(Miami downtown people mover)

DESIGNING TO LIVE WITH WATER

Water Management, Natural Resources,
Transportation, Planning & Development

"TO PROTECT COASTAL REGIONS OF SOUTH FLORIDA WE WILL NEED TO CONSIDER MULTIPLE THREATS INCLUDING SEA LEVEL RISE, RISING GROUNDWATER TABLE, AND POTENTIAL CHANGES TO EXTREME RAINFALL. PROJECTIONS OF THESE VARIABLES ARE INHERENTLY UNCERTAIN – FUTURE RESILIENCY WILL REQUIRE IMPLEMENTATION OF ADAPTIVE PATHWAYS WHICH FOCUS ON BOTH SHORT- AND LONG-TERM SOLUTIONS."

— Obey Jayantha, Chief Modeler, South Florida Water Management District



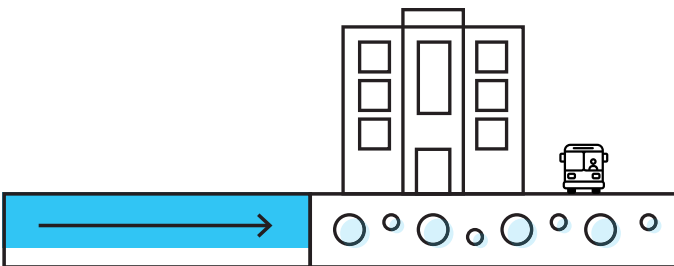
Fig. 1 Culvert installation

Photo: South Florida Water Management Department, Flickr

WATER MANAGEMENT

South Florida is literally awash in water: saltwater, freshwater, stormwater, and wastewater. The region faces many of the same water management challenges in adapting to rising sea levels as other waterfront regions: mitigating floods, protecting fresh drinking water, and managing sewer overflows. But several factors unique to South Florida make these challenges particularly difficult.

- The region lies on porous limestone, which allows groundwater and saltwater to seep up through the ground into the thousands of miles of the region's vast water management system, causing flooding "from below" even on sunny days or without tidal waves topping sea walls. Miami Beach has invested roughly \$500 million to deal with chronic flooding, including installing up to 80 pumps that vacuum floodwaters back out to the ocean.
- The region's water management infrastructure systems, designed more than 70 years ago to separate and contain water, were not built to accommodate the region's present-day population and never anticipated sea level rise.
- Rising seas threaten not only more frequent flooding but also saltwater intrusion that contaminates drinking water and damages everything from roads and electrical systems to plants and freshwater habitat. Several municipalities in the region have constructed desalination plants to take salt out of brackish groundwater. The cost of constructing desalination plants has been estimated at \$6 billion to treat just one-third of the water needed for Southern Florida.



"WATER WILL BE THE BIGGEST CHALLENGE TO PROTECTING THE INFRASTRUCTURE WE NEED TO MAINTAIN OUR WAY OF LIFE — TOO MUCH AS WELL AS TOO LITTLE. WATER POSES A THREAT TO BOTH THE BUILT INFRASTRUCTURE WE LIVE IN AND THE WATER SUPPLY THAT SUSTAINS US."

— Fredrick Bloestcher, Professor, Department of Civil,
Environmental and Geomatics Engineering, Florida
Atlantic University



Biscayne Bay

Photo: Christophe33132, Pixabay



Fig. 2 Cocohatchee Weir 1 temporary pumps

Photo: South Florida Water Department, Flickr

KEY THEMES

Seawalls are not enough

Because of its porous geology, the region can't rely on building walls to keep the ocean out. New approaches and ideas are needed to adapt to a new reality of inundation: protecting freshwater, infrastructure, and property from saltwater intrusion, and managing the damage caused by floods that occur even on sunny days.

Live with water

As in many regions around the world, South Florida's water infrastructure was designed to get water out of developed areas as quickly as possible. But learning to live with water—re-using and storing it, slowing it down, making it visible—can help boost water supply, improve its quality, and provide education opportunities, while still protecting communities from flooding.

Invest wisely

In February 2018, the South Florida Water Management District approved a plan to spend \$1.9 billion in water infrastructure capital improvements. This investment presents a huge opportunity to incorporate planning

for sea level rise into capital plans and to design infrastructure projects to be more resilient.

Coordinate at different scales

Many municipalities have local stormwater plans but few can fully control their stormwater alone. Local plans and infrastructure must be integrated with their regional counterparts, or water management issues can be made worse.

Fig. 1 SFWMD field station crews are installing a culvert in western Miami-Dade County to convey additional water to the headwaters of Taylor Slough in the Everglades.

Fig. 2 Cocohatchee Weir No. 1 Temporary Pumps. South Florida Water Management Department crews have completed installation of two 42-inch temporary pumps at Cocohatchee Weir No. 1 in Collier County. The pumps are operating to help lower water levels in the Big Cypress Basin flood control system following Hurricane Irma.



Miami canal

Photo: Florida Fish and Wildlife, Flickr

NATURAL RESOURCES

South Florida is synonymous with beaches, the Everglades, and the ocean. But the way we perceive, manage, and impact these and other ecological systems must change. Development pressures, stormwater runoff, rising temperatures and seas, and storms that will be more frequent and intense in the future all pose potentially catastrophic threats to the health of the region's ecological systems.

Beach erosion

Nearly half of Florida's coast—411 miles' worth of beach—is considered "critically eroded." Miami-Dade County lost nearly 170,000 cubic yards of sand during Hurricane Irma. In 2017, the county depleted its offshore sand reserves: from now on, sand to replenish eroded beaches must come from outside the region.

Wetlands

In 2017, the *Miami Herald* reported that Biscayne Bay has lost more than 21 square miles of seagrass over the past decade—an area bigger than the city of Miami Beach.

Water quality

Hotter weather and stronger storms with heavy rains that flush fertilizers and nutrients from the region's farms and lawns create perfect conditions for algae

blooms. These blooms, which now occur roughly every two or three years in South Florida, starve aquatic life of needed oxygen, threaten water quality, and create a sludgy green froth on the surface of water bodies that negatively impacts tourism. A 2016 study found that more than half of potential visitors considered delaying their travel to Florida because of an algae bloom that summer.

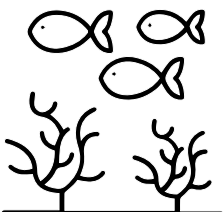
Habitat and native species

Out of 1,200 species tracked by the Florida Natural Areas Inventory, 25 percent are likely to lose at least half of their current habitat due to sea level rise alone.¹

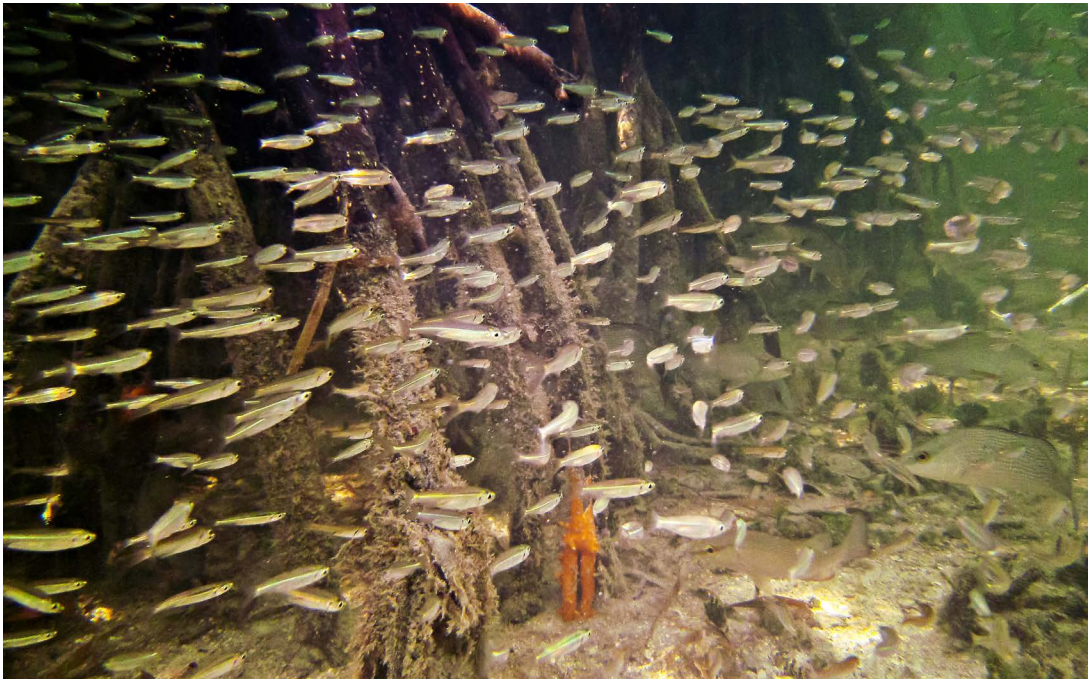
1. "Climate Change Impacts on Florida's Biodiversity and Ecology," in *Florida's Climate Book*, ed. Eric P. Chassignet, James W. Jones, Vasubandhu Misra and Jayantha Obeysekera (Gainesville: Florida Climate Institute, 2017): 339.

"FLORIDA'S NATURAL SYSTEMS ARE CLEARLY BEING IMPACTED BY SEA LEVEL RISE AND OTHER CLIMATE CHANGE IMPACTS, BUT THEY ARE ALSO A KEY PART OF THE SOLUTION TO THE CLIMATE CHALLENGES FACING PEOPLE. BY HELPING THEM THRIVE, WE ARE HELPING OURSELVES TOO."

— Chris Bergh, Director of Conservation, South Florida,
The Nature Conservancy



25% of species are likely to lose their current habitat.



Underwater mangrove island

Photo: Phil's 1stPix, Flickr



Everglades wildfire

Photo: Florida Fish and Wildlife, Flickr

KEY THEMES

[Integrate nature and the built environment](#)

South Florida can make room for habitat, wildlife, water, and other kinds of natural systems as an integral part of new development, protective infrastructure, and roads. Overlaying engineered systems into the region's complex hydrological and geological systems will require new approaches and best practices that prioritize people, animals, and plants.

[Ecosystem-responsive development can offer new strategies for growth](#)

Developers and environmental advocates don't always have to be adversaries. The challenge is that conventional five-year development cycles are at odds with ecosystem timeframes. However, it's possible to find sites and development projects where investment opportunities align with ecologically sound principles, leading to new opportunities and products for developers, and helping contribute to environmental conservation, mitigation, and adaptation.

[Quantify and codify natural systems](#)

Research models can calculate the dollar value of the region's ecosystems, and the social, economic, and

health impacts of ecosystem damage. Decision makers should consider these costs when evaluating a given development project and when creating new plans, capital projects, and regulations.



Miami Metromover leaving the OMNI station to cross Biscayne Blvd.

Photo: James Good, Flickr

TRANSPORTATION

The Greater Miami region is the sixth most congested county in the U.S.² The region has a dedicated funding source for public transit improvement thanks to a tax passed in 2002 and the recently adopted Strategic Miami Area Rapid Transit (“SMART”) plan, which prioritizes advancing six regional rapid transit corridors and a bus rapid transit network.

As with other car-dominated regions, South Florida must extend public transportation networks to high-density residential areas that lack good access, while also making transit more convenient in places where good access exists. These challenges are exacerbated by a fragmented governance system, with 23 transportation planning agencies across seven counties and 121 towns and cities. Climate change further complicates long-term decision-making, as key stakeholders must consider where future investments may be threatened by flooding and storm damage.

- More than one in eight Miami-Dade households do not have a personal vehicle.³ Buses provide two out of three public transportation rides in the county.
- Traffic congestion costs Miami drivers more than \$3.6 billion per year.⁴

- Within the four counties that make up the Southeast Florida Regional Climate Change Compact (Broward, Miami-Dade, Monroe, and Palm Beach Counties), the transportation sector contributes 45 percent of its greenhouse gas emissions. Much of this is attributable to “family and personal” trips in single-occupancy vehicles.⁵



"RESILIENCE GOALS FOR SOUTH FLORIDA MUST ADDRESS THE REGION'S TRANSPORTATION SYSTEMS. WE NEED TO START CHANGING PEOPLE'S ATTITUDES ABOUT PUBLIC TRANSIT, WALKING, AND BIKING, AND WE MUST TAP INTO NEW OPPORTUNITIES THAT ARE EMERGING FROM TRANSPORT AND TECHNOLOGICAL INNOVATIONS. BY RETHINKING URBAN TRAVEL AND ENCOURAGING TRANSIT-BASED DEVELOPMENT, WE CAN IMPROVE COMMUNITY HEALTH, AND THE REGION'S PUBLIC SPACES AND QUALITY OF LIFE."

— Nancy Clark, College of Design Construction and Planning, University of Florida; Director, UF Center for Hydro-Generated Urbanism (CHU); Founder and Program Coordinator, UF G|SoA Global Lab



Downtown Miami flooding

Photo: Carvalho, Flickr



Adrienne Arsht Center bus terminal

Photo: Ed Webster, Flickr

KEY THEMES

Integrate and expand

The region's commuters too often have to patch together multiple modes (bus, walking, train) that aren't coordinated and result in punishingly long travel times. The region needs expanded transit networks that reach more places and are better integrated.

Mitigation is no small thing

Solutions to reduce the transportation sector's contribution to the region's greenhouse gas emissions may seem insignificant in the face of global greenhouse gas emissions. But in fact, these solutions, and the ongoing efforts to advocate for and educate people about them, can have major impacts on policy-making. The region's progress can influence state and congressional leaders, which in turn can help shape national and international policy.

Go east to west

The region's transportation system historically has been oriented parallel to the coast. More connections are needed going east to west, particularly in high-density, low-income neighborhoods currently lacking good transportation options.

Think like a rider

Climate change will bring more extreme heat to the region's tropical climate, making already stigmatized alternatives to car travel even less attractive. Bike paths, transit, and sidewalks need shade, plants, and other amenities to make these options more attractive to diverse groups of people.

Take the long view

Transportation and built environment planning are driven by short-term expediencies of politics and tax revenues. The region needs long-term investment in public transportation to reverse years of declining ridership, and stakeholders need to develop forward-looking transportation plans that lay out a regional vision for the next 30 to 50 years.

2. James F. Murley, Jane Gilbert, Susanne M. Torriente, *Preliminary Resilience Assessment, Resilient Greater Miami & the Beaches* (Miami: 100 Resilient Cities—Pioneered by the Rockefeller Foundation, 2017): 26.

3. Cathleen Kelly, Miranda Peterson, and Madeleine Boel, *Miami-Dade in Hot Water: Why Building Equitable Climate Resilience is Key to Public Health and Economic Stability in South Florida* (Center for Community Progress, January, 2016): 13.

4. Global Traffic Scorecard. INRIX, February 20, 2017.

5. *Regional Greenhouse Gas Emissions Inventory Baseline Period: 2005–2009* (Southeast Florida Regional Climate Change Compact, November 2011).



High tide flooding at construction site pit in Brickell

Photo: MiamiBrickell, Flickr

PLANNING & DEVELOPMENT

South Florida is an epicenter for both climate change and real estate booms and busts. The region also hosts stark contrasts in development. For instance, in Greater Miami, nearly 29,000 luxury condominium units have come online since 2010. At the same time, more than 20 percent of the population lives in poverty.⁶

With rising rents and housing stress still lingering from the recent recession, many residents fear displacement, including from homeowners and investors buying properties in low-income neighborhoods on relatively high ground.

Florida recently revised its building code to strengthen flood protections and put in place other adaptations to sea level rise, and Miami-Dade County is currently revising its Comprehensive Development Master Plan. How and where to develop will continue to be central questions for the region for years to come.

- The region has a relatively flat landscape; for instance, half of the developed areas of Miami-Dade and Broward Counties lie at five feet above sea level or below. In Greater Miami, more than 85,000 people and 53,000 homes are located on land less than three feet above high tide. More than \$21 billion in assets are at risk from sea level rise.⁷

- Currently, close to 60 percent of Miami-Dade households are considered financially unstable and one in five households live in poverty. Poverty levels are the highest among African-American and Hispanic communities, which together make up 85 percent of Miami-Dade's population.¹⁰



- Greater Miami is the country's third least affordable housing market. From 2009 to 2015, average rents in the region increased 65 percent (from \$1,505 to \$2,501). In 2014, more than two thirds of renter households and more than half of owner households were considered by the U.S Department of Housing and Urban Development to be "cost-burdened" (paying more than 30 percent of their income on rent).¹¹

"SOUTHEAST FLORIDA HAS ALWAYS LIVED WITH STORMS AND FLOODS. CLIMATE CHANGE IS NOT SO MUCH A NEW RISK AS AN AMPLIFIER OF EXISTING RISKS, AND WE MUST MODIFY OUR PLANNING AND DEVELOPMENT REGULATIONS ACCORDINGLY. JUST AS REGULATORY REQUIREMENTS HAVE HARDENED OUR BUILT ENVIRONMENT TO HURRICANE WIND RISKS, WE CAN ADAPT TO CLIMATE CHANGE'S INCREASED FLOOD RISKS BY BUILDING HIGHER, STRONGER, AND WISER."

— Jim Murley, Chief Resilience Officer, Office of Resilience,
Miami-Dade County



Biscentennial Park in Miami

James Good, Flickr

- 6. *Preliminary Resilience Assessment*, 66.
- 7. *Preliminary Resilience Assessment*, 20.
- 8. *Miami-Dade in Hot Water*, 6.
- 9. *Florida's Climate*, 297.
- 10. *Miami-Dade in Hot Water*, 5.
- 11. *Ibid.*, 6.



Miami density

Photo: Miamibrickell, Flickr

KEY THEMES

Capitalize on the region's strong planning tradition

Although South Florida may not be synonymous with urban planning, the region has a strong planning tradition. For instance, in many other places, plans are simply guidelines or recommendations, while more narrowly focused tools such as zoning are legally binding. Miami-Dade County's plans are enforceable by law. The elevated status of plans gives local stakeholders opportunities to develop resilient strategies for development that can have impact in the real world.

Incentivize resilient development

In areas that can support greater density, targeted incentives could help encourage developers to implement flood protection strategies. For instance, developers could receive a bonus allowing them to construct taller buildings in exchange for paying into a "resilience fund" or paying for specific infrastructure improvements.

Create opportunities for cooperation across jurisdictions

Government officials typically don't have the opportunity to work with colleagues from neighboring municipalities. But South Florida is bringing government officials together across jurisdictions to address climate change. For instance, a pilot Adaptation Action Area—a planning tool to prioritize initiatives in areas most vulnerable to climate change in the region—convenes staff from five cities and unincorporated Dade County as

well as the South Florida Water Management District to address stormwater management issues.

Start talking about where not to build

In 2016, the Southeast Florida Regional Climate Change Compact convened scientists, designers, government officials, and other experts alongside local residents to share hypothetical visions for the future of Miami's Shorecrest neighborhood, which routinely floods during high tides. Among the recommendations: convert high-risk residential areas to open spaces that can hold water during high tides and rainy seasons. In this scenario, property owners would voluntarily sell their properties to the local government. Discussing this kind of transition is never easy, but these kinds of conversations will be necessary as some areas flood more and more frequently.

CASE STUDIES

Ripple Effect, Living Shoreline Seawall Renewal



Mangrove planters

Photo: Michael Singer

LIVING SHORELINE SEAWALL RENEWAL

LAKE WORTH, PALM BEACH COUNTY

The Living Shoreline is a prototype for a cost-effective modular system to supplement existing seawalls, providing coastal coastal defense while also allowing ecological systems to function and thrive. Installed within the Lake Worth Lagoon next to a public park, the project is a collaboration between Michael Singer Studio, an art, design, and planning firm; the Palm Beach County Department of Environmental Resources Management (DERM); and engineer of record Bridge Design.

Why does it matter?

Conventional seawalls are simply blank walls that offer no habitat value and don't protect shoreline soils. A common alternative, rip-rap (stacked rocks), requires extensive hauling of rocks from quarries. The Living

Shoreline modules can protect the adjacent seawall, public park, and infrastructure while also supporting the restoration of habitat for fish, oysters, and mangroves, helping to improve water quality.

The team did not want to create a prohibitively expensive module that couldn't be replicated in other contexts. The modules are engineered with fiberglass rebar and fibers to withstand wave action but use far less material than conventional alternatives such as rip-rap and require much less time, labor, and heavy equipment to install. (Later versions of the module utilize 100 percent recycled concrete aggregates, while still achieving a 5000 psi minimum strength.) Once a module is installed, and a mangrove population is established, the modules are designed to be able to be moved to and re-used in other locations, leaving



the mangrove anchor behind. If enough modules are fabricated, the studio believes that a permanent mold could be made and the modules could be cost competitive with rip-rap.

How did it get started?

Michael Singer Studio had worked with DERM on previous ecological design projects. The studio approached DERM with a proposal to create an innovative prototype for an urban, ecologically high-performing living shoreline system that could replace the conventional model. The team chose a site adjacent to a public park where restoration work was already proposed and permitted by DERM.

How does it work?

The Living Shoreline is comprised of 11 modules, roughly 10 feet long and five feet high, that were designed and engineered to resist wave action, retain soils to support the growth of mangroves and emergent grasses, create shelter and passage for fish, and establish oyster reef habitat. The modules have “shelves” that were carefully calibrated to maximize oyster growth and fish habitat.

How was it funded?

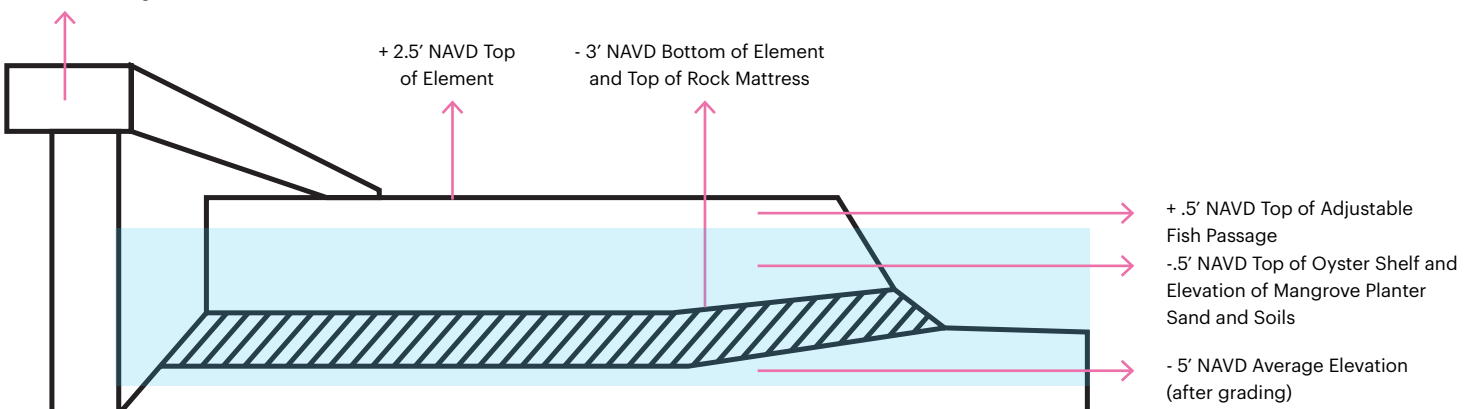
Michael Singer Studio and DERM applied for and received a grant from the National Endowment for the Arts (NEA), through a program that supports the creation of art and design that has public benefit. The grant allowed the county to work with the studio to develop a prototype living shoreline system as a public art project and also funded the fabrication. The design incorporated input from marine biologists and structural engineers. DERM matched this seed funding, and Palm Beach County ultimately funded the creation of a full one hundred linear foot Living Shoreline seawall comprised of 11 sculptural elements. The county is also providing ongoing monitoring for the prototype; studying this system will help in improving the next prototype design.

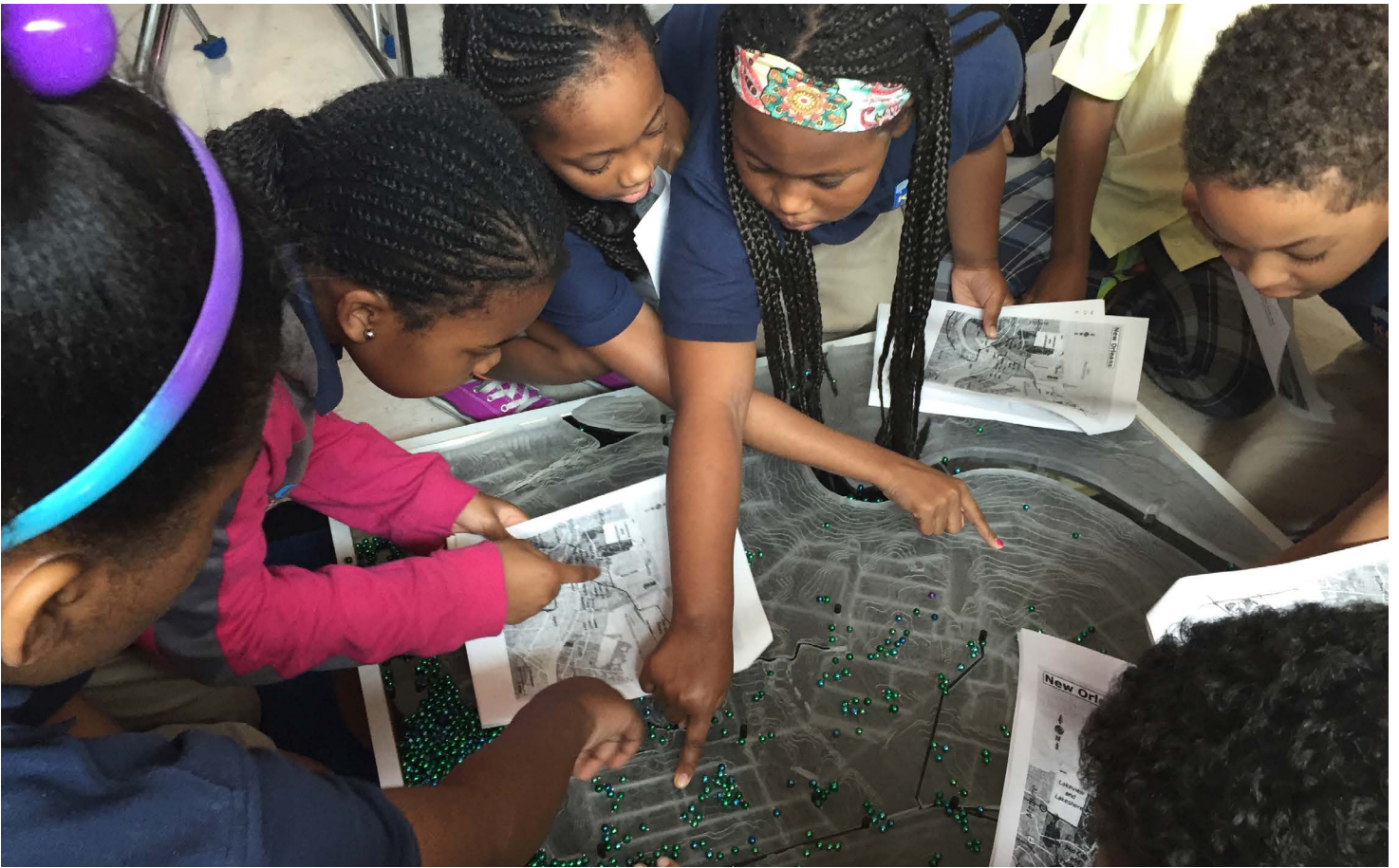


Mangrove planters

Photos: Michael Singer

Illustration based on Michael Singer Studio's "The Living Shoreline Perspectival Elevations"
+ 5.9' NAVD Top
Seawall (existing)





Ripple Effect students

Photo: Ripple Effect Water Literacy Project

RIPPLE EFFECT NEW ORLEANS

Ripple Effect is an initiative bringing together teachers, designers, and water experts to work with students throughout Greater New Orleans to build water literacy and to develop solutions to pressing water challenges that their communities face.

Why does it matter?

Ripple Effect's philosophy is that in coastal regions, water literacy is a basic aspect of citizenship; everyone needs some basic knowledge about water management to make informed decisions about the region's future. The project aims to engage a generation of kids, particularly children of color, to become environmental stewards and active citizens on water-related issues, while learning about design as a potential career.

How did it get started?

The project began with the question: How can designers and other key stakeholders engage the public about sea level rise and other impacts of climate change? One of the founders, Aron Chang, is a designer who was then working on the Greater New Orleans Urban Water Plan, a comprehensive water management plan for the region. His friend and co-founder Claire Anderson, then a fourth grade teacher at a local charter school, realized that no one in her circles (other teachers, parents, students) was talking about the water plan and how it might affect their lives.

Together, Chang and Anderson developed a multi-week pilot curriculum engaging students in a group design project to learn about coastal cities around the world and to address flooding in the school's courtyard,



using the school as a microcosm of larger water management issues.

How does it work?

Rather than developing a standardized water management curriculum, Ripple Effect realized it could have a greater impact by training teachers across the region to develop their own tailored curriculum for their classrooms. Participating teachers get a stipend to spend one hundred hours learning content and design-based teaching practices. Teachers visit pump stations, urban wetlands, and green infrastructure projects to see firsthand how water management works in New Orleans. They practice design themselves, for instance, by learning how drawing a section can be more effective for communicating coastal erosion than just text alone. Finally, they receive support creating and implementing new curriculum aligned with state and national science standards, and using design as a way for students to apply the science they learn and to practice stewardship in the classroom.

The project got seed funding from the city's Sewerage and Water Board, which each year is required by the U.S. Environmental Protection Agency to issue RFPs for community education and in-school education projects.

What is its impact?

At KIPP Central City Primary, the school where Ripple Effect started, the curriculum that staff, teachers, and students developed culminated in their replacement of the asphalt courtyard with a new landscape of rain gardens, cypress trees, and a large play mound—features that demonstrate what sustainable water management can be like for a school campus.

Across the region, Ripple Effect has reached nearly 1,000 students, and the organizers are beginning to track impacts through pre- and post-project surveys. For instance, when students are asked in surveys who is responsible for water management problems such as roads to their school being flooded, participants in the program are more likely to say they themselves can take responsibility to change the situation.



KIPP City Primary

Photos: Ripple Effect Water Literacy Project

RESOURCES

RESOURCES

DATABASES

Bureau of Economic and Business Research

Produces Florida's official state and local population estimates and projections. These estimates and projections are used for distributing state revenue-sharing dollars to cities and counties in Florida and for budgeting, and planning and policy analysis by state and local government agencies, businesses, researchers, the media, and members of the general public.

Florida Geographic Data Library (FGDL)

The mechanism for distributing spatial (GIS) data throughout the state of Florida.

Miami-Dade County Open Data Portal

The central site to access Miami-Dade County's data.

National Oceanic and Atmospheric Administration Office for Coastal Management Digital Coast

Data sets range from economic data to satellite imagery. The site contains visualization tools, predictive tools, and tools that make data easier to find and use. See especially "Sea Level Rise Inundation Data Sets."

Office of Economic and Demographic Research

Research arm of the Florida Legislature principally concerned with forecasting economic and social trends that affect policy making, revenues, and appropriations.

Sea Level Rise Sketch Planning Tool

A planning tool for preliminary assessment of transportation infrastructure vulnerable to current and future flooding created by the University of Florida GeoPlan Center.

GOVERNMENT AGENCIES AND INITIATIVES

Jacksonville District U.S. Army Corps of Engineers

Second largest civil works district in the Army Corps encompasses Florida and the Caribbean.

Southeast Florida Climate Compact

The compact represents a new form of regional climate governance designed to allow local governments to set the agenda for adaptation while providing an efficient means for state and federal agencies to engage with technical assistance and support. Broward, Miami-Dade, Monroe, and Palm Beach Counties executed an agreement in January 2010 to coordinate mitigation and adaptation activities across county lines.

South Florida Water Management District

Regional governmental agency that manages the water resources for 16 counties and roughly 8.1 million residents. Responsible for managing and protecting water resources of South Florida by balancing and improving flood control, water supply, water quality, and natural systems.

POLICY AND PLANNING DOCUMENTS

Comprehensive Everglades Restoration Project (CERP)
Authorized by Congress in 2000 as a plan to “restore, preserve, and protect the south Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection.”

Florida Department of Transportation Office of Policy Planning
Lists various FDOT plans and studies, including the Florida Seaport System Plan and Florida Waterways System Plan.

GreenPrint & the Climate Action Plan,
Miami-Dade County
GreenPrint articulates the key sustainability priorities of Miami-Dade County’s government, community and economic partners, as well as concerned residents. See also “Climate Action Plan,” an integral component of GreenPrint.

Miami-Dade County Sea Level Rise Task Force Report
Recommendations relative to the Comprehensive Development Master Plan, capital facilities planning, and other priorities to begin the process needed to design and build a re-engineered urban infrastructure.

Miami Beach Sustainability Plan
Plan to improve resources, prevent harm to the natural environment, protect human health, and benefit the social, economic, and environmental well-being of the community for present and future generations.

Regional Climate Action Plan (RCAP 2.0)
Based on a collaborative, multi-jurisdictional process, the Southeast Florida Regional Compact’s 2012 action plan included over 100 recommendations to prepare the Southeast Florida region for climate change. In 2018, the compact published RCAP 2.0 as an interactive website allowing users to access updated recommendations in custom plans based on their interests and expertise.

Resilient Greater Miami & The Beaches: Preliminary Resilience Assessment
Overview of existing conditions in the region, produced as part of the 100 Resilient Cities planning process.

Strategic Miami Area Rapid Transit (SMART) Plan
Officially adopted by Miami-Dade County in 2016, the SMART plan aims to create six “rapid transit corridors” and six Bus Rapid Transit networks. Although the

SMART plan originally recommended rail for the transit corridors, some municipal officials now argue for “smart bus systems” as a cheaper alternative that could also adapt to driverless technology.

Unified Sea Level Rise Projection Southeast Florida
Unified regional projection based on global projections, guidance documents and scientific literature for use by the Southeast Florida Regional Climate Compact counties and partners for planning purposes to aid in understanding potential vulnerabilities and to provide a basis for developing risk-informed adaptation strategies for the region.

CLIMATE CHANGE ADAPTATION: ADVOCACY, IMPACTS, SOLUTIONS

Adaptation Action Areas: Policy Options for Adaptive Planning For Rising Sea Levels

A planning guidebook helps Florida's local governments to designate "Adaptation Action Areas" for areas that are vulnerable to flooding and sea-level rise, in order to prioritize funding in those areas for infrastructure needs and adaptation planning.

CLEO Institute

Miami-based not-for-profit organization in Miami, FL solely dedicated to climate change education, engagement, and advocacy. Engages stakeholders through climate literacy training workshops, town hall forums, and other channels, with a focus on under-resourced communities.

Florida's Climate: Changes, Variations, and Impacts

A 2017 book with contributions from more than 90 researchers at universities across the state and beyond to address sea level rise, water resources, and how climate affects various sectors, including energy, agriculture, forestry, tourism, and insurance.

Miami Transit Eco System – A Micro Primer

YouTube video offers an overview of the region's "transportation ecosystem," introduces primer various agencies and entities responsible for the region's transportation network.

South Florida Water Sustainability and Climate Project

Provides an hydro-economic model for South Florida that optimizes water allocations based on the economic value of water.

The Southeast Florida Regional Climate Compact's Shoreline Resilience Working Group's interactive map of regional climate change adaptation projects.

MEDIA OUTLETS, ARTICLES, AND PUBLICATIONS

This section highlights a handful of articles and publications that provide useful overviews or address specific aspects of climate change adaptation in South Florida. Many more articles can be found from Miami Herald and Miami Times, which have reported extensively on climate change adaptation in the region.

Overview articles

Jeff Goodell, "Miami: How Rising Sea Levels Endanger South Florida." Rolling Stone, June 20, 2013.

Elizabeth Kolbert, "The Siege of Miami." New Yorker, December 21, 2015.

Laura Parker, "Treading Water." National Geographic Magazine, February 2015.

Specific topics

Josh Baumgard, "Miami metro as the most dire need for affordable housing in the country, per report." Curbed, August 15, 2017.

"Bloom and Bust: Algae takes heavy toll on Florida tourism." UF News, August 4, 2016.

Joey Flechas and Jenny Staletovich, "Miami Beach's battle to stem rising tides." Miami Herald, October 23, 2015. A two-part overview of more than \$400 million plan for pumps, elevated streets, and other infrastructure adaptation to prevent flooding.

"Shrinking Shores." Naples News, 2016. A 2016 series of articles by local newspaper on beach erosion in the region.

Publications

Eric P. Chassignet et al., editors, Florida's Climate: Changes, Variations, & Impacts. Florida Climate Institute, 2017.

Nancy Clark and Kai Uwe Bergmann, Miami Resiliency Studio. University of Florida Center for Hydro-Generated Urbanism, 2015.

Cathleen Kelly, Miranda Peterson, and Madeleine Boel, Miami-Dade in Hot Water: Why Building Equitable Climate Resilience is Key to Public Health and Economic Stability in South Florida. Center for Community Progress, January 2016.

Harvard Graduate School of Design, Office for Urbanization, Fall 2015.

Miami Beach: The Project on South Florida.



A project by

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