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# PROTECTING SOUTH FLORIDA:

*June 2020*

**A DISCUSSION OF SEA LEVEL RISE,  
PROPERTY AND REGIONAL PLANNING**

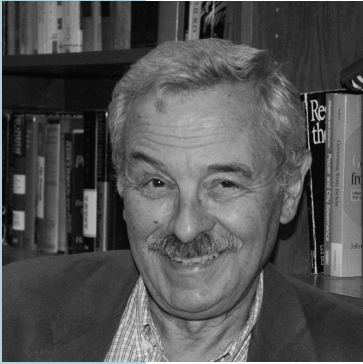


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CENTER FOR URBAN &  
ENVIRONMENTAL SOLUTIONS  
Florida Atlantic University

# PROJECT TEAM

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**Does Where We  
Sit Tell Us Where  
We Stand?**



Problems of climate change and sea level rise (SLR) are hardly new to Floridians. After all, we sit on one of the longest state coastal plains in the nation. We also sit in a subtropical area, often saturated by rains, storms and humidity. It should come as no surprise that in an era of weather threats Florida would be at the top of the “most vulnerable” lists. What is at question is where Floridians stand on the SLR issue. We see a gap between the threat of a waterlogged future and the lack of commensurate consumer reaction to that threat. The data suggest that Floridians understand weather hazards. According to FAU’s Center for Environmental Studies, 72% of Floridians are in favor of teaching climate change in public schools; another 55% believe climate change is real and caused by human activity, and almost half (47%) are willing to pay \$10 per month to strengthen the state’s weather related infrastructure (Center for Environmental Studies, 2019).

Yet, for all the awareness, waterfront property continues to be bought at premium prices and built upon as if nothing mattered. With limited and notable exceptions, we might as well be living in the 1970s. Floridians, new-comers, and short termers alike build as they had during the last century. Even Florida’s state and local governing institutions largely remain unchanged and have little capacity for contending with weather hazards. True, South Florida has forged a Climate Change Compact between localities in four counties, but this is still a voluntary coordinating mechanism that conducts research, not an instrument for establishing enforceable, binding decisions.<sup>1</sup>

We explore the twin challenges of climate change threats (ie. SLR) and South Florida’s prospects for establishing formal institutions capable of dealing with these threats (regional planning/governing bodies). The specifics of our first challenge relate to SLR’s effects on property values. While research on the subject is cautiously tentative, it has gone as far as estimating the susceptibility of property at different elevations to price fluctuations and traced the actual effects of recurrent flooding on property values. The questions loom. What is at stake and how can we best explain the behavior of Floridians regarding those stakes? To what extent do property values change when struck by weather disasters? Do measures toward mitigation and adaptation alleviate marketplace shocks? The second challenge encompasses how regional institutions can mitigate or adapt to catastrophic weather events. What kinds of region-wide governance are possible in South Florida? What powers can regional institutions be accorded in order to deal with climate change?

One matter is clear. Where we sit does tell us something about where we stand. The crucial issue is whether we have the determination to do something about rising sea levels and how we might go about fulfilling that resolve. Our purpose is to cast some light on this issue and clarify the alternatives available to South Florida.

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<sup>1</sup> We refer here to collective action on a regional scale because that is the most feasible way to prepare, plan and carry out decisions. As we shall see, a number of localities, indeed, have acted on weather challenges to the best of their individual abilities. See Southeast Florida Compact, 2014.



# 02

## **Why Sea Level Rise in South Florida?**





South Florida embraces the four counties of Monroe, Miami-Dade, Broward, and Palm Beach.<sup>2</sup> The counties comprise more than 6,060 square miles, they hold over six million people, and together they generate more than \$337 billion in personal income annually.<sup>3</sup> The combined real property value is assessed at more than \$833 billion.<sup>4</sup> South Florida is home to the 73rd largest metropolitan area in the world, the seventh largest in the United States, and the largest in Florida. The importance of South Florida to the rest of the state is nothing short of spectacular. These four counties are filled with vibrant, coastal wonderlands whose businesses generate 37 percent of the state's GDP (Southeast Florida Compact, 2014). They not only hold the key to Florida's economy, but can open political doors. With 30% of the state's population, South Florida's demographics make a difference in electing governors and choosing legislators. The region

may even affect national politics, as Florida's electoral votes are often pivotal in Presidential elections. For the moment most everything appears to be normal in South Florida and it buzzes with large inflows of people and capital. One would hardly know this area, the size of a small state, stands at the precipice of disaster. Its most valuable natural asset of a long coastline, low flat land and beaches that lap onto populated neighborhoods place South Florida in the direct path of the destructive forces of climate change (Fourth National Climate Assessment, 2018).

Climate forecasting is a complex, many-sided business where specific timing and severity of predictions will sometimes differ. Nonetheless, the inevitability of sea level rise threatens every locality on the continental coastline. The science behind it is solid and not encouraging for those seeking to be reassured about its potential for damage. In any projection, South Florida lies directly in the path of impact. While conclusive evidence is still wanting, accounts suggest that sea levels are projected to rise significantly and geophysical forces will bring tides ever higher—each time from an elevated preceding launch level (Southeast Florida Compact, 2015:5; Wdowinski, 2016)

The rush of water through streets and shopping malls is aggravated by heavier rainfalls (warmer air carries more moisture), outmoded drainage (failure to renew infrastructure), and hard, impermeable surfaces (sprawled development). Human activity has made matters worse by releasing more greenhouse gases (GHGs) into the air and accelerating global climate change.<sup>5</sup>



10th and Alton in Miami Beach.  
(photo by Arianna Prothero WLRN)

<sup>2</sup> The Metropolitan Statistical Area (MSA) is a significant subset of South Florida and encompasses Miami-Ft. Lauderdale-West Palm Beach

<sup>3</sup> Most data are based on projections and updated up to 2017 or 2018. See US Bureau of the census at the following: <http://edr.state.fl.us/content/area-profiles/county/palmbeach.pdf>: <http://edr.state.fl.us/content/area-profiles/county/broward.pdf>: <http://edr.state.fl.us/content/area-profiles/county/miamidade.pdf>: and, <http://edr.state.fl.us/content/area-profiles/county/monroe.pdf>. For land area see <https://www.indexmundi.com/facts/united-states/quick-facts/florida/land-area#map>

<sup>4</sup> Most recent data are available for 2018. Property Tax Research and Analysis at [PTOResearchAnalysis@Floridarevenue.com](mailto:PTOResearchAnalysis@Floridarevenue.com).

<sup>5</sup> National climate assessment are made periodically and often change. The Fourth National Climate Assessment, US Global Change Research Program, Climate Science Special Report, Chapter 2, 2017. <https://science2017.globalchange.gov/chapter/2/>

# Why Sea Level Rise in South Florida?

## 02

Using 2000 as the mean for South Florida, sea level is projected to rise 10 to 17 inches by 2040; 21 to 54 inches by 2070; and, 40 to 136 inches by 2110 (Southeast Florida Compact, 2019). Thus far projections have increased with each measurement. Keep in mind the variation on SLR can be considerable and is dependent upon GHG emissions. For this reason, major studies on the subject portray SLR designated by various curves of certainty. Other researchers rely on a different calculus for South Florida and show SLR accelerating at roughly a quarter of an inch per year (Wdowinski, et al. 2016).<sup>6</sup>

We should be clear about the impacts of climate change. It is unlike other threats the nation has experienced and from which it has recovered. For example, the threat from earthquakes along the western coast of the U.S. presents very different challenges. Over long timeframes, geology helps us define specific seismically vulnerable locations and enables localities to engineer resilient infrastructure and housing. Available economic resources may hinder the mitigation of these risks, but there is little question about what should be done to become more resilient to this risk. By contrast climate change is unyielding and it drives episodic events like

**EVERY INCH OF SLR BRINGS GREATER EXPOSURE TO PEOPLE AND THEIR PROPERTIES. ONCE THE TIDE LINE RISES, MORE ASSETS ARE COVERED IN ITS WAKE. AT LESS THAN THREE FEET ABOVE THE HIGH TIDE LINE, OVER 2000 SQUARE MILES LIE IN THE FLOOD ZONE ALONG WITH AN ESTIMATED \$145 BILLION IN VANISHED HOUSING; AT SIX FEET ABOVE THAT TIDE LINE THE AMOUNT OF EXPOSED LAND JUMPS TO OVER 4000 SQUARE MILES AND \$544 BILLION IN LOST PROPERTY VALUE.**

cyclones, floods, and wildfires. Its chronic effects such as SLR and increased ocean temperatures do not disappear once the storm has passed. Our only recourse is to act in anticipation of its occurrence; by getting to the sources of rising

The threats are not just to private property. Roads, bridges, power plants, airports, sewer lines, other infrastructure, and military bases all lie within these new *de facto* floodplains. Our national heritage of museums, monuments, and natural treasures could be covered by surging seas within a century. Fresh water sources are also at risk by intruding saltwater threatening drinking water supplies, while septic tanks are likely to burst under increased sea pressure, spreading contaminants into critical fresh water aquifers.

seas, halting bad practices, and preparing for a climate crisis that are certain to eventually come. Essentially, we must change our approach to the climate or face the consequences of more frequent and severe impacts.

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<sup>6</sup> That is, between 5.9 and 7.4 millimeters per year.



A black and white photograph of a beach scene. In the foreground, a large, white, stylized number '03' is superimposed over the image. To the right, a lifeguard stand with a wooden deck and a sign is visible. In the background, several people are relaxing on lounge chairs under beach umbrellas. The overall tone is somber due to the monochrome palette.

# 03

## **Why Sea Level Rise is so Important**



Turn to any story on weather related disasters and South Florida is often the point of reference. No wonder. South Florida's longitude runs for 120 miles along a low-level coastline, portions of which consist of a lattice-like limestone (karst) where water can easily seep into, up-through, and around its porous surface. Florida alone has more areas at-risk to SLR than any other state. Table 1 illustrates that risk shared by the top ten most vulnerable states and localities.

Billions of dollars of resources and assets continue to be built in flood-prone areas. Investors and residents continue to purchase properties, construct on vacant waterfronts, and otherwise extend an infrastructure to support that expansion. Media accounts report that investors are little daunted by the prospect of having properties washed away by oncoming seas. Indeed, the most sought-after land is at-risk parcels, mostly located along the coastline with ample views of the sea.

**TABLE 1**  
Most at Risk States, Localities and Cities

RANK	TOP 10 STATES	TOP 10 COUNTIES	TOP 10 CITIES
1	Florida	Miami-Dade, FL	New Orleans, LA*
2	Louisiana*	Broward, FL	New York, NY
3	California	Jefferson, LA*	Hialeah, FL
4	New York	Orleans, LA*	Metairie, LA*
5	New Jersey	Lee, FL	Pembroke Pines, FL
6	Virginia	Pinellas, FL	Cape Coral, FL
7	Texas	Nassau, NY	Miami Beach, FL
8	North Carolina	San Mateo, CA	Plantation, FL
9	South Carolina	Collier, FL	Miramar, FL
10	Massachusetts	Hillsborough, FL	Fort Lauderdale, FL

\* Includes significant populations on land already under the local high tide line, and protected by levees  
Source: Strauss, *Tebaldi, Ziemiński, Sea Level Rise, Storms and Global Warming in Climate Central, 2012*

Roughly half of the most vulnerable cities, counties or metros are located in Florida. Miami-Dade County leads the crowd. Seven of the ten at-risk U.S. cities are also located in Florida, highlighted again by South Florida (Hialeah, Miami Beach, Plantation, Miramar, and Fort Lauderdale). Using metropolitan areas as the sole criterion, a report by Zillow Research (2017) lists the Miami-Dade metropolis as the most vulnerable to rising seas, followed by Tampa (3rd) Fort Meyers (4th), Bradenton (9th), and Naples (10th) (Zillow, 2017:1).

Media accounts describe builders as “very bullish” on South Florida real estate with “multimillion-dollar homes built all over Miami Beach” (Miami Herald, June 7, 2017) and announce that “Foreign Investors Shrug off Miami’s Rising Sea Levels”; describe ultra-modern luxury hotels; and report that buyers are “snapping up” properties in South Florida, sight unseen (NPR, May 21, 2019).

# Why Sea Level Rise is So Important

## 03

However, as reported in a recent news coverage by CNN, developers and investors in Miami are beginning to take notice of neighborhoods that are located on higher ground. In communities like Little Haiti, which is on average three-feet higher than other nearby neighborhoods, the idea of climate gentrification has begun to take hold. While investors from as far away as China have been fueling a land grab in this impoverished community, not all of the reasons point to SLR. The proximity of Little Haiti to downtown Miami, the coast and other assets might have been sufficient to bring about gentrification anyway. Nevertheless, CNN notes that in South Florida the new real estate mantra is “location, location, elevation.” (CNN, July 11, 2019)

Despite some increasing awareness of the role of SLR on property values in cities like Miami, the reality is that most investors and developers have yet to make the connection. What accounts for the disparity between fact and perception? While much is brought about by the allure of a subtropical seacoast location, a number of reasons might explain Miami’s construction bubble. Development is by nature a speculative enterprise where investors seek an edge in identifying the best potential prospects. Once those prospects are chosen, economies of agglomeration take hold, creating circular causation in which initial investment generates still more investment. In what can be described as a herd mentality, property investment begets more investment. Even if investors perceive a risk, they are by nature “risk takers” who believe they can depart before the bubble breaks.

There are two other factors at work that stoke a willingness to take on risk. Moral hazard is the term

used to describe the promotion of risky behavior for which others bear the consequences of failure. The current construct of the National Flood Insurance Program (NFIP) provides an example of moral hazard by providing homeowners in areas of recurrent flooding with insurance at costs below actuarially sound rates; therefore, putting forward an inducement for dangerous behavior (GAO, 2014).

Local governments find themselves in a similar bind by offering investors protection against rising seas. The dilemma for local governments is apparent. On the one hand, localities that choose to leave waterfront properties unprotected would find their most valuable tax bases severely eroded as floods and storm surges destroy them. On the other hand, localities that choose to protect those properties face their own moral hazard by facilitating and encouraging still more high-risk development.

Another reason for the fact-perception disparity is that investors hold to the belief that SLR is slow and they have plenty of time to unload properties on still unknowing buyers. Finally, we have the theory of “asymmetric information,” where relatively few individuals are knowledgeable enough to discount (reduce) land prices in anticipation of rising seas (Bernstein, Gustafson and Lewis (2018). Stuck with financial calamity are amateur investors left in an information lurch. Asymmetric information is often cited as a driver of the 2007-2008 global financial crisis.

The asymmetric information explanation is appealing and supported by Bernstein’s, Gustafson’s, and Lewis’ (2018) groundbreaking study on the relationship



between SLR and property values. The authors find that property markets are “highly segmented” (rental investors trade with one another) and that non owner-occupied housing (rental investments) is far more susceptible to pricing discounts than owner occupied housing (homeowners).

As the argument goes, rental investors are “sophisticated buyers” who have a “long term horizon”—as much as a century ahead of the curve when it comes to calculating property values. They are likely to discount risky property well in advance of any potential jeopardy. Accordingly, rental investors trading in “segmented markets” discount the price of risky housing by an average of 7 percent (Bernstein, Gustafson and Lewis, 2018: 1,3).

Bernstein and his colleagues advance their “long-term horizon” thesis by placing properties in different SLR “exposure buckets.”

Specifically, it addresses why rental investors are more prudent about SLR than homeowners, who seem to lack evidence about rising seas (arguably). Herbert Simon (1947) coined the term “bounded rationality” to describe conditions of this sort, limiting one’s ability to make optimal decisions (due to cognition, circumstances, biases, availability, etc.). Still, bounded rationality goes only so far, and there may be other reasons for the absence of investor alarm about rising seas.

We suggest that distant time horizons may account for why SLR has failed to impress many property buyers. For one, SLR tipping points are generally reported to be far enough into the future that buyers are not discouraged. If oceans in South Florida are rising  $\frac{1}{4}$  inch per year, the buyers may rationalize that they may be safely overlooked for ten years or more. Another part of this is that amenities (ocean views, boating and beach usage, and fresh sea breezes) do balance, if not

**PROPERTIES LIKELY TO BE INUNDATED AFTER ONE FOOT OF SLR SELL AT A 14.7% DISCOUNT; PROPERTIES AT 4-5 FEET OF SLR TRADE AT A 7.8% DISCOUNT; ALL THE WAY TO 6 FEET OF SLR TRADING AT A 4.4% DISCOUNT.**

By contrast owner occupied housing does not appear to be significantly affected by climate change, until homeowners become worried about SLR—even that classification requires the homeowner to be “very worried” (somewhere in the 90th percentile of “worry”) to warrant an 8.5% discount (Bernstein, Gustafson and Lewis, 2018: 21).

The “long-time horizon” approach offers a powerful explanation about varying sensitivities to rising seas.

outweigh, buyer reluctance (Atreya and Czajkowski, 2014). In short, SLR remains an abstraction, until there is something really big to worry about. Accelerating SLR also adds to the damage done from cyclones and King tides, but buyers may not always make that connection or understand its acute significance.

Researchers do find something big to worry about. Studies of climate change in Florida have been geared to high profile though vulnerable areas. Thus far,

# Why Sea Level Rise is So Important

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Miami-Dade County (especially Miami Beach) and the Florida Keys (Monroe County) have received the bulk of attention. Wdowski et al. (2016) set a broad agenda for Miami-Dade by analyzing a raft of data on actual flooding by frequency and level. These researchers drew results from an accumulation of data on rain, tide, and storm surge. Again, the results show a gradualism toward flooding, with significant peaks and troughs punctuating weather cycles. While the upward ratcheting of SLR is undisputable, it does not inhibit some investors from fixing their attention on the troughs rather than long term trends. Be that as it may, facts continue to stand as stubborn reminders that rainfall, SLR, and tide levels feed on each other. The evidence tells us that between 2006 and 2013 rain events increased by 33 percent and tide events rose by 400 percent, making it impossible to escape the fact that large swatches of South Florida are indelibly written into a chronic flood zone (Wdowski et al. 2016: 3).

A complementary set of studies of Miami-Dade County also shed light on the subject of SLR and

property values. [Keenan et al. \(2018\)](#) take one approach to this issue while [McAlpine and Porter \(2018\)](#) follow a different path. Both studies converge around the proposition that exposed properties lose value over time.

Keenan et al. put forth an “elevation hypothesis” by comparing flood prone properties at higher and lower elevations in Miami-Dade. They show properties at higher elevations enjoy better price appreciation than their lower level counterparts. As the authors put it, “elevation had a positive effect in 24 of 25 jurisdictions.” “Those (same) jurisdictions represent 98.1 percent of the properties” that were studied (Keenan et al, 2018: 7). McAlpine and Porter corroborate Keenan’s findings by examining the effects of “tidal flooding” and “hurricane storm surges.” Focusing on “repeated tidal flooding,” the authors find that between 2005 and 2016 the average lot, worth \$722,000, would lose over \$14,372 in value by the year 2032 (McAlpine and Porter, 2018: 891). According to the authors, total lost property values came to \$465 million in Miami-Dade (McAlpine and Porter, 2018: 871).



Construction in Miami (photo by Gaetano Cessati Unsplash)





Similar losses were recorded for hurricane storm surge flooding and often the two types of flooding overlapped, making for still greater increments of lost value.

While some of the data are clear and corroborate the overall SLR/property value hypothesis, other data are subject to different interpretations and are sometimes inconsistent with the theory. We should remind ourselves that the reported “losses” are not absolute losses but theoretical losses on top of theoretical increases in land values. Owners of “exposed property” may very well lose out on added price differentials, but still walk away with a profit. This is likely to be perceived quite differently than incurring a net loss on investment. Moreover, the causal connection between SLR and property values can be confounded by other factors, such as market booms and busts, design trends for smaller or larger houses and the condition of the regional economy at a given point in time.

Time is the key element in any projection. For McAlpine and Porter, the projections go out to the year 2032. Trying to convince a property owner that he or she will lose under 2 percent of the property value 13 years from now is hardly a persuasive reason for many people to act on climate change. Neither are the total losses impressive from the standpoint of overall property values. A projected \$465 million loss in the total real estate market is quite tiny (.001 percent) relative to a total assessed valuation in Miami-Dade of \$327.2 billion (Florida Department of Revenue, 2019). Keenan et al. (2018) admit as much when they break down land according to different elevations and discuss relative gains in value for each elevation. While these writers are able to describe property gains ranging between 6.5 feet (2 meters) and 19.6 feet (6 meters), they do point out that cohorts at higher elevations, “had *slightly*

(italics added) higher rates of price appreciation” (Keenan et al., 2018: 5). The “slightly” qualifier comes into play again as they observe, that the highest housing elevations had only “slightly outperformed” lower elevated housing. “Slightly” is hardly sufficient to arouse the public about SLR.

There is too a nagging null hypothesis to consider. While Keenan and his colleagues corroborate the “elevation hypothesis” by showing that 76% of their sample held a positive relationship between elevation and price, the City of Miami Beach stood out as an exception. Miami Beach exhibited a notably “negative relationship between elevation and price appreciation” because of its “proximity to coastal water” (Keenan et al., 2018: 3,9). This anodyne reduction of Miami’s magnificent coastline as merely being “proximate to water” misses so very much about the context through which statistics should be read. Purchasing behavior is not a pure economic calculation and the sentiment of an ocean view can have a powerful influence, no matter the risk. Granted, Miami Beach is only one jurisdiction among the 25 examined, but it is a very important locality, and it exemplifies the importance of “amenities” in persisting as an important influence on property prices. From a theoretical perspective we have a serious gap between fact and perception.

There are other complicating factors. Ocean front property in Miami Beach is largely home to the very wealthy and various commercial interests (such as hotels and restaurants).

Many of these properties produce significant municipal income by way of commercial activity and real estate taxes and are an essential to the “Miami Beach brand.” For this reason, the city has chosen to invest public

# Why Sea Level Rise is So Important

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dollars in their protection by pursuing expensive weather impact measures centering on adaptation and mitigation. Notwithstanding these initiatives, protecting the affluent with public funds is controversial and raises the specter of middle class and poorer neighborhoods not only being neglected, but effectively paying to safeguard a privileged social class (Goodell, 2017).

Despite perceived equity concerns, the Miami Beach strategy should be credited for taking some action on SLR, which is more than other municipalities have done. Miami Beach has just completed a business case analysis of its investments in stormwater management (roadway and parcel elevations). The analysis of the roadway elevations in one neighborhood, Sunset Harbour, show a positive benefit to property values (11.9% since 2017) from these investments. The analysis also predicts that parcel elevations and nearby roadway elevations will result in significant increases in value (between 5 and 10% increase in value for each foot of elevation). This is consistent with other studies, discussed later in this paper, and may provide a process by which to quantify the return on investment to the municipal tax base as well as benefits for individual parcel owners (City of Miami Beach, 2019).

The super vulnerable Florida Keys appear to be in an altogether different category. There, even property investors have not rung SLR alarms loudly or enough times, perhaps because of its allure. The Keys are an arcuate chain of about 800 keys with a land area of

approximately 139 square miles. They begin south of Biscayne Bay and extend in a southwest direction toward the Gulf of Mexico. The residential population of this island chain is over 72,000 with the main center at Key West (holding 30 percent of the total). As of 2016, the total value of land was put at \$22.8 billion (Florida Keys News, 2016). The map to the right guides the reader through this island chain. Zhang et al. (2011) conducted a study of SLR and property value of those Keys lying within Monroe County.

There are differences in the risks faced by the Upper and Lower Keys. When it comes to property damage the Upper Keys are better off, at least under less severe scenarios. A low scenario SLR rise (1.9 feet) on these islands would bring \$2.2 billion in real property damage. A high scenario rise (4.9 feet) would entail over \$13.4 billion in real property damage (Zhang, et al, 2011: 137). In all scenarios, the Lower Keys are more severely affected. A low-rise scenario of 1.9 feet would result in \$2.37 billion in real property damage. Even under a low-rise scenario Big Pine Key, which houses the National Key Deer Refuge, would be submerged and lead to the loss of a primary habitat and possible extinction of a unique subspecies of the North American white-tailed deer.<sup>7</sup>

A high-rise scenario in the Lower Keys would erase more than \$14 billion in real property (Zhang, et al, 2011: 140). Effectively, under low-rise scenarios much of the Florida Keys would be noticeably damaged.

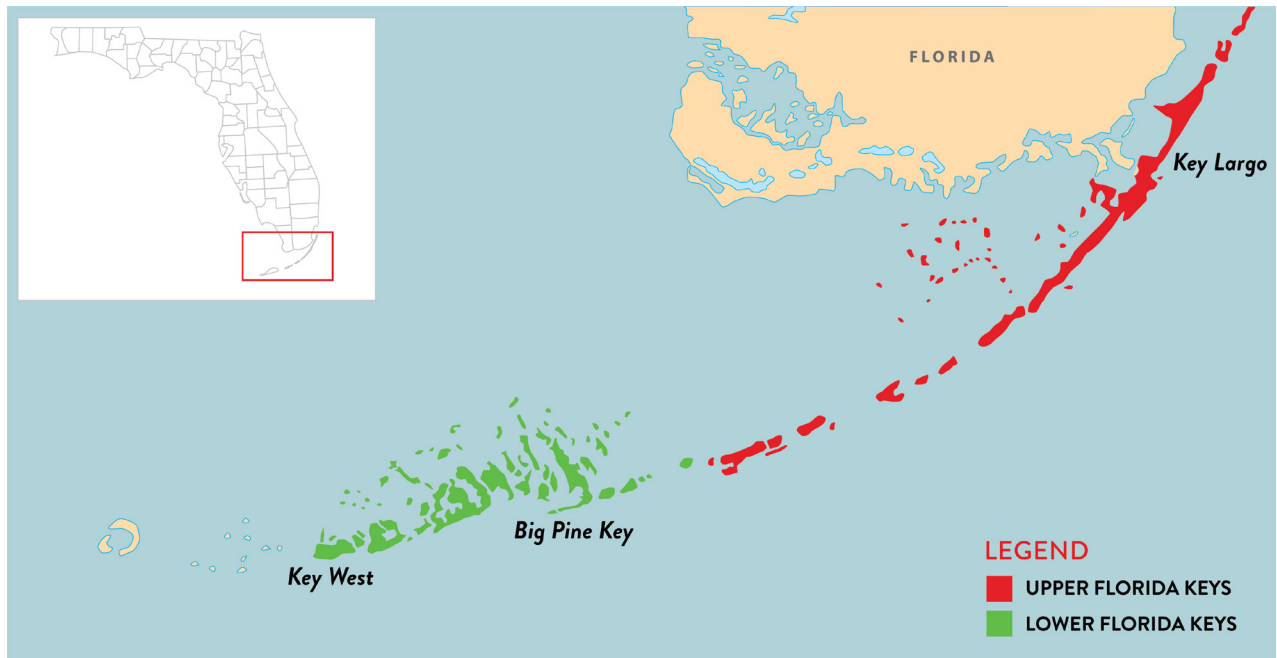
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<sup>7</sup> The effects are significant for survival of natural habits and fresh water. Even a small 7.8-inch rise (0.2 meters) in sea level would eliminate Sugarloaf Key. See for example, Sink, Swim, or Take the Higher Ground: Challenges Facing Rare Species Management in the Florida Keys, Texas A&M Natural Resources Institute, <https://nri.tamu.edu/blog/2018/august/sink-swim-or-take-the-higher-ground-challenges-facing-rare-species-management-in-the-florida-keys/>



## FIGURE 1

Florida Keys SLR and Property Study Area



Once high-rise scenarios come to pass, the Florida Keys would become little more than small specks of land sitting in the midst of an ocean.

We note here the relationships are non-linear, making the worst scenario turn into a complete catastrophe sometime during the 21st century. There is a tipping point at approximately 1.3 feet (0.4 meters) beyond which the inundation impact on population and property

accelerates rapidly. Before this tipping point is reached, the consequences for Key West are manageable. After that point (currently projected between 2050-2060) the potential acceleration of sea level rise amplifies and becomes difficult to halt. In sum, SLR poses unavoidable near-term consequences, if nothing is done to slow down the effects of climate change or reduce the vulnerabilities. We explore those consequences and the choices they engender in the next section.

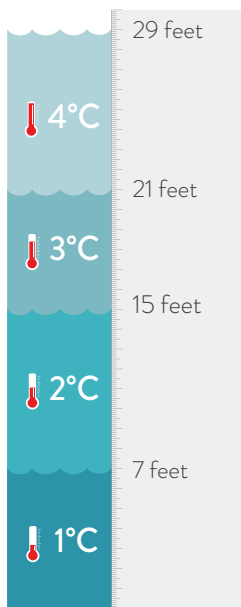
# U4

## **What's Ahead and What are the Choices?**





We see a disjuncture between expressed preference and revealed preference. Expressed preference is what people talk about—like climate change. Revealed preference is the choice people actually make in normal life—like buying seaside property.<sup>8</sup> The disjuncture is couched in two seemingly contradictory “despites.” Despite the denials, climate change is coming to be accepted—especially where it counts, in the halls of Congress, state houses, and governors’ mansions. Yet despite the acceptance, consumer choices have not changed, and governments are very slow to act.<sup>9</sup> Perhaps part of the problem is that the investing segment of the public may well understand the timescale of SLR impacts, but has not yet chosen to act upon it.



*Degrees of temperature rise associated with feet of sea level rise*

Sooner or later the larger public will be obliged to do something about climate change. In just 20 to 60 years from now, we will most assuredly see significant effects across large parts of the U.S. and the world. Indeed, many of these effects are already being felt, but may not be consciously attributed to climate change. The average temperature in cities is expected to rise by 2.7 degrees Fahrenheit (1.5 degrees Celsius). One degree, two degrees or three degrees may seem small to some, but they make a profound difference for industry, lifestyle, and resilience.

The *Surging Seas Seeing Choices* website (<https://seeing.climatecentral.org/>) provides a mapping tool for anywhere in the world that allows users to observe the impact of SLR based on a global temperature rises up to 4 degree Celsius. The models predict a 7 foot (2.1 meter) increase in SLR with a one-degree Celsius temperature rise. Two degrees Celsius is modelled at 15 feet (4.5 meters), three degrees Celsius is 21 feet (6.4 meters) and four degrees Celsius is 29 feet (2.7 meters).

It is important to note that most discussions of climate change are in the context of “average” temperature increase, and that a two-degree average increase may result in extreme temperatures that are much higher (or lower) than the average. Winter cities, like Minneapolis, will begin to resemble year-round summer cities like Miami. Summer cities like Miami will feel closer to sweltering cities, like Panama City, Panama. Florida has a real stake in global climate change, not just because of property loss, but because it is bound to degrade the composition of the state. As one journalist put it, “want to know what your [northern hemisphere] city will feel like in 2080? Look 500 miles south” (Borunda, 2019).

We are already seeing the expansion of hurricane and wildfire “seasons” with more severe episodes occurring on the shoulders of the current seasons, aligned with warmer ocean temperatures and extended droughts. Hurricane Michael made landfall in 2018 as a Category 5 late season tropical cyclone and was the only storm of this intensity to strike the mainland U.S. in 20 years.

<sup>8</sup> While this paper emphasizes coastal Florida, we recognize that inland areas face even greater challenges. The limestone geology of Southeast Florida extends westward and all the way to the Everglades (with some exceptions). There are many places in the west that have greater (eventual) concerns than places in the east. Though beyond the scope of this paper, western areas deserve proper attention.

<sup>9</sup> Nevertheless, government has begun to change, particularly in Florida. Earlier denials about climate change are starting to fade. Florida Governor Ron DeSantis has begun to address environmental and weather hazards. Early in his term Gov. DeSantis issued a directive cleaning up water and voicing his opposition to fracking and offshore drilling. He then appointed a chief science officer to coordinate environmental research and a chief resilience officer to coordinate adaptation efforts. Gov. DeSantis alerted officials in the state’s Department of Environmental Protection to make sure their decisions are based on the best available science. Gov. DeSantis also formed a new Office of Resilience and Coastal Protection. More recently, he reversed an order of the previous governor that forbade the use of the term “sea level rise.” Granted, these are small steps and they still disappoint environmental groups as being too weak. But they do carve a new path toward climate realism.



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## 04



Destroyed docks and damaged boats in Panama City, Florida, show the results of Hurricane Michael's landfall in the Florida Panhandle.

(©2018 Genesis Photo Agency/photo by Michael Spooneybarger)

Scientists are still studying the relationship between warmer ocean temperatures and storm intensity, but tentative thinking holds that as storms gather energy from warmer water, they grow in severity. The cycle of climate change is well established. Ice sheets in faraway places melt because of atmospheric and ocean warming conditions: Warm air holds more moisture; Moist air precipitates increased rainfall; Increased rainfall brings on flooding; In tandem, all of these occurrences produce rising seas.

Added up, climate change makes some properties more valuable than others. If revealed preferences do not

change sooner, they will be made to change by financial institutions that support property markets, such as insurance companies, banks, mortgage providers and long-term bond holders. Much as amenity locations have dictated the value of property in the past, so too will climate change begin to determine housing prices in the future. With that, capital will move from one geographic location to another. In decades to come we can expect substantial market adjustments away from some areas and into others.

The triggers begin in the natural environment and shift rapidly toward financial institutions. Climate disasters



will take a toll on properties, either making them too expensive to repair or sold at deep discounts. Eventually, insurance premiums will become too expensive to absorb or coverage will no longer be available for at-risk properties. This may be delayed by federal subsidy and disaster aid policies, but these measures are unsustainable and constitute a fiscal risk to the federal budget (GAO 2019). Parallel actions will be initiated in higher mortgage rates or the termination of mortgages in recurrent flood zones. Water clogged streets and inundated highways also will add to the burden, making business less affordable. In any case, funding must come from somewhere and higher taxes or special assessments will be required to cover the costs.

The very conditions that made South Florida so attractive—pleasant weather, excellent amenities, low taxes, and an affordable lifestyle—are likely to be in jeopardy. Florida could see a reversal of the immigration it was so privileged to enjoy during the last century. The term “climate gentrification” has come to describe this state of affairs. Keenan et al. (2018: 2) view this as a shift in property markets and as “the substitution of property from an inferior to a superior location.” To buttress the point, they suggest that a cohort of “speculative property investors in South Florida has already begun to hedge its investments and gradually exit for higher ground in central and north Florida” (Keenan et al, 2018: 3).

From another perspective, climate gentrification entails the exodus of population from less resilient environments toward more resilient environments. The upshot: large-scale disinvestment in exited localities and infusion of

investment into new areas. Hauer (2017) and other researchers predict large outflows of residents away from coastal properties and toward inland areas, leading to one of the great human migrations of all time.<sup>10</sup> Using samples of IRS and Census data from over 300 coastal communities, they examine current migratory patterns into 3,000 safer counties. Migratory patterns will be spurred by what Hauer (2017) calls “press events” like SLR or droughts (continuing, gradual weather stresses) and “pulse” events like cyclones and high category hurricanes (sudden weather shocks that come and go). Southeastern and Gulf Coast states are likely candidates for the press of SLR and the pulse of hurricanes. By their account, Florida could lose 2.5 million and Texas 1.5 million residents (Hauer, 2017: 10).

The situation is further complicated by immigrants fleeing the devastations wrought by hurricanes in Puerto Rico and the Bahamas. These pulse events are likely to cause further waves of immigrants into South Florida. Thus, disaster planning should take into account a layering of refugee populations settling from one disaster area into another.

While it is unclear which events will be the greater spur, both “press” and “pulse events” will act in some combination to drive locational decisions. Where are those locational decisions likely to lead? Chances are that migrating households will rely upon “pre-existing pathways” to leverage established “networks of social capital and kin” as the basis of choice. The dynamic corresponds with a massive migration into land locked or elevated localities (Hauer, 2017: 3). The plain states

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<sup>10</sup> Hauer is not alone in making these points. For other research see Black, et al, 2011; Black et al, 2013 and Findlay, 2011.

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of Iowa, South Dakota, and North Dakota are often cited as destination points along with mountain states of Colorado and Utah. However, as has been seen in the past several years, these areas are experiencing significant riverine flooding, intermittent water scarcity issues and severe wildfires. There may, in fact, be far fewer safe havens from climate changes, and no easy escape from the problem.

No doubt, there are many points to consider in Hauer's presentation. For one, the projections cited are based on 5.9 feet (1.8 meters) of SLR; well over a century ahead (with the possible exception of a worst-case occurrence in the Lower Keys). Second, as Hauer points out, we are referring to "unmitigated" weather events. States and localities have begun to do something about mitigation and adaptation.

Currently, efforts are focused on building and deploying sea walls, beach and marsh renewal, pumps, elevated

roadways, raised housing, and armoring waterfronts. While the costs of expanding these initiatives are immense (an estimated \$4.2 billion annually), they can be spread over decades.

And third, we can still reduce the level of future impacts. There is still time to opt for some level of source control—mitigating the very conditions that have accelerated SLR and other impacts of climate change. This, at least in the U.S., has become a partisan political issue. Nationally, nearly three quarters of Americans (73%) believe global climate change is happening and only 15% believe it is not occurring, according to a survey in late 2018. This is a ten-point increase from an earlier (2015) survey suggesting the acceptance of climate change science is increasing nationally (Leiserowitz, et al., 2018).

In South Florida, the increased attention is likely due to the state finding itself on the front pages of climate



Miami Beach is Raising Streets by 2 Feet to Combat Rising Seas  
(Source <https://www.miamirealestateguy.com/>)





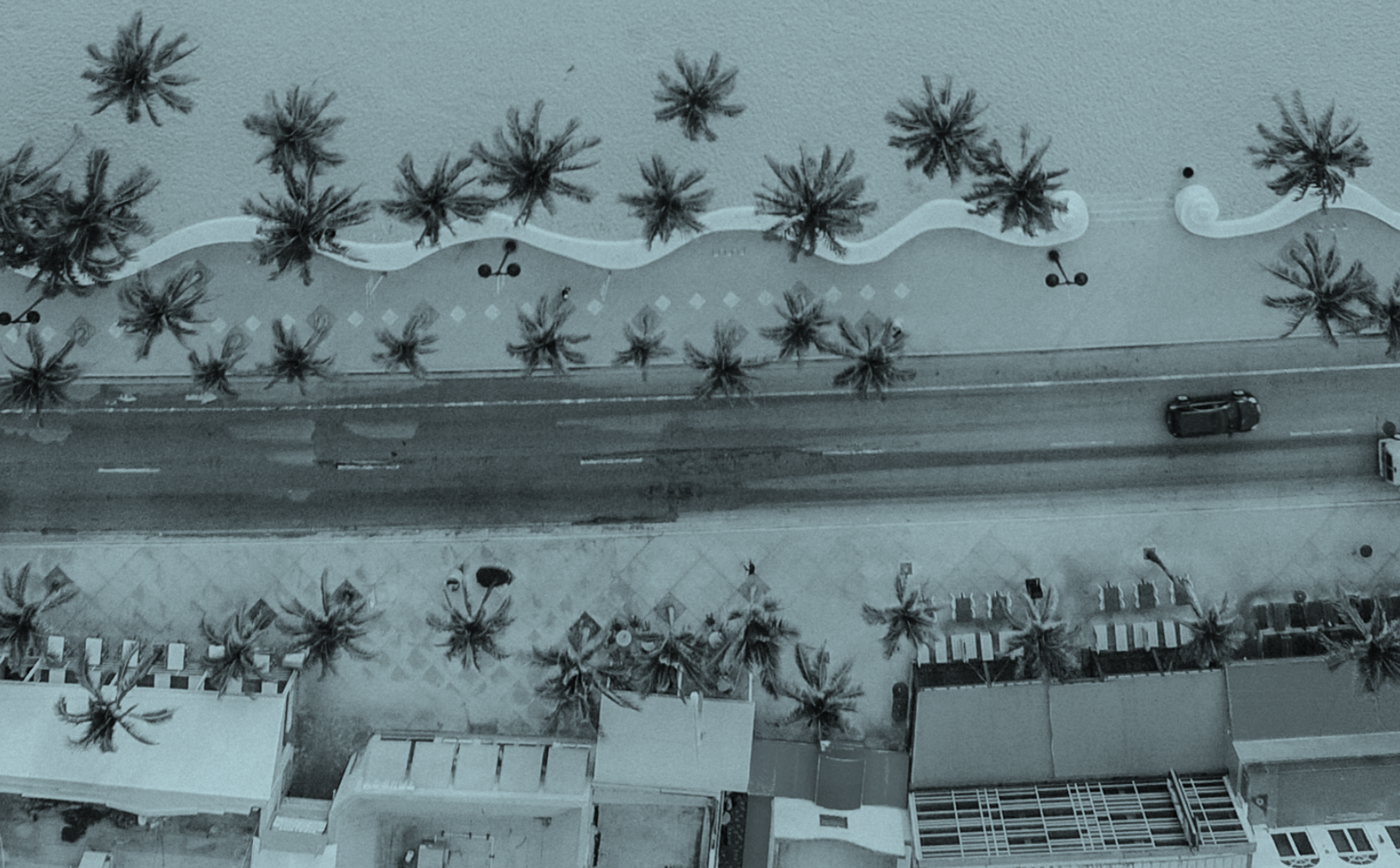
change impacts. Because of this, we now see more bipartisan acknowledgement of the facts around climate change, especially in highly vulnerable areas. A recent survey of Florida residents fairly well reflects a narrowing of partisan differences and shows an increased acceptance of human induced climate change (Center for Environmental Studies, FAU, 2019). In Florida, work has begun on how the state might convert to a lower carbon future. Thus far, that discussion focuses on efforts to identify realistic scenarios that utilize tools such as carbon pricing to create a market-driven effect."

In a survey of 20 coastal communities, researchers found that more than three quarters have plans underway to deal with rising seas. These include binding commitments to "hazard identification," "vulnerability assessments," "action plans," and a "mitigation strategy" (Butler, et al., 2017: 324). Almost every community has begun to talk about measures to combat SLR and 72% of those under study have undertaken some kind of capital investment (Butler, et al., 2017: 325-326). Clearly, attitudes have changed, and local officials have now shifted from a "wait and see" to a "watch and see" approach. Modest as this may be, "watch and see" obliges communities to monitor SLR, consult the science of climate change, and "take into account" new threats, so they can be addressed. How this can best be done and what it means for South Florida is the subject of our next discussion.

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" The discussion is still controversial and even some Democratic Presidential candidates have shied away from specifics. See, Pathways to 2050: Alternative Scenarios for Decarbonizing the U.S. Economy, 2019, <https://www.c2es.org/content/pathways2050/>

# What Kinds of Policies and Measures are We Talking About?



The costs and benefits of adaptation measures are an understudied subject, in part because storm intensity is not easily predicted and, having risen precipitously in recent years, damages are even less foreseeable. America's costliest storms, which are individual storms that cost in excess of \$20 billion, have nearly all occurred during the last 15 years and are becoming more common and more costly.<sup>12</sup> We have come to expect them each "hurricane season" along with rising budgets and insurance costs. The effects of these storms are not always understood, especially when considered in the context of how well mitigation and other adaptation measures have worked. The varying intensity of storms and different conditions on the ground (densities, housing age, and infrastructure type) make it difficult to generalize. Nevertheless, we learn more with every passing event and with each unusual occurrence. As adaptive measures are taken, they provide a record, allowing researchers to develop modeling techniques and draw estimates about their economic payoffs.<sup>13</sup>

Table 2 classifies the most common types of resilience investment in Miami and New York. While geared to different types of cities with different weather events, the list is fairly representative of other coastal communities.

Much of Miami-Dade's investment has focused on lacing its coastline with "grey infrastructure" such as seawalls, pumps, and road elevation. Within the larger metropolis of Miami-Dade, the City of Miami has chosen to build its way out of weather threats by promoting "Miami Forever" bonds to armor its coastline with hard infrastructure. New York City's investment strategy is broader and concentrates on modernizing individual buildings and critical facilities. New York is also exploring larger infrastructure solutions such as a \$10 billion plan, which would extend the shoreline of lower Manhattan creating new (higher) land and a coastal barrier.

**TABLE 2**

Resilience Investment Measures Implemented in Miami Dade and New York City

CLASSIFICATION	MEASURES
Infrastructure hardening	Levee, Dike, Sewall, Floor protection berm, Breakwater, Elevating roadways, etc.
Critical facility hardening	Public service building reinforcement (excluding raising foundation)
Drainage-Absorption improvement	Erosion control, drainage and stormwater system, beach nourishment, swales, green restoration, etc.
Emergency preparedness	Hurricane shelter, back-up generators, Pump installation, at-risk building demolition, etc.
Recovery operation	Emergency repair for public infrastructure and critical facilities, etc.

Source Modified: Sueng Kyum Kim, "The Economic Effects of Climate Change Adaptation Measures", Working Paper, Graduate School of Design, Harvard University, 2019.

<sup>12</sup> Only Hurricane Andrew, which caused \$50 billion of damage in 1992 occurred prior to 2004. NOAA's National Centers for Environmental Information maintains a list of all weather-related disasters causing more than \$1 billion in damages. <https://www.ncdc.noaa.gov/billions/events/US/1980-2019>

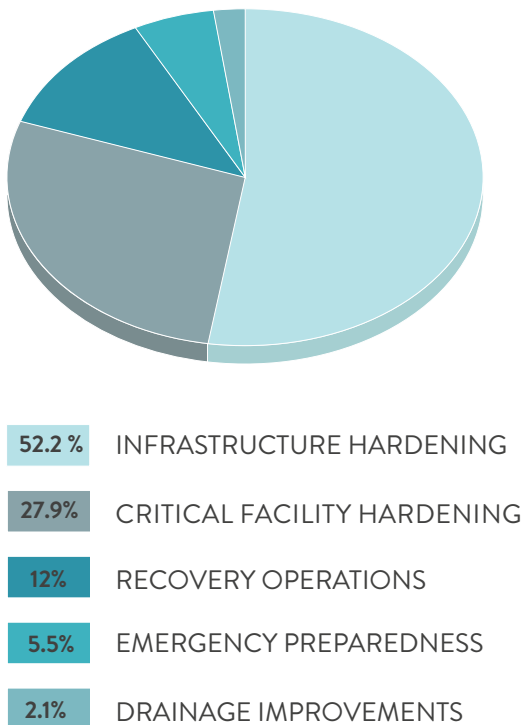
<sup>13</sup> These consist of geospatial modeling, hedonic regression analysis used in combination with extensive panel data on property transactions, storm reports, hurricane tracks and flood data. See Sueng Kyum Kim, "The Economic Effects of Climate Change Adaptation Measures", Working Paper, Graduate School of Design, Harvard University, 2019.



## 05

**FIGURE 2**

Miami-Dade efforts towards mitigation and adoption



In both cities, a smaller but important portion of resilience investment is allocated toward green infrastructure, namely the restoration of beaches, the construction of dunes and berms, and the preservation and expansion of green space. During a seven-year period (2011-2017) total green infrastructure expenditures for Miami-Dade amounted to \$326 million, while New York City spent substantially more at \$1.6 billion. However, New York City had significant federal recovery funding in the aftermath of Hurricane Sandy in 2012.

For reasons of relevancy, we highlight the Miami-Dade experience.<sup>14</sup> The most common measures taken by Miami-Dade include infrastructure hardening (52.5 percent) followed by critical facility hardening (27.9 percent), recovery operations (12 percent), emergency preparedness (5.5 percent) and drainage improvements (2.1 percent).

Overall, impact on house prices in Miami-Dade have been quite positive. The Miami-Dade experience tells us that, following a major hurricane (Category 4 or 5), prices of all houses declined for approximately five months, but those that were protected quickly recovered and substantially appreciated in value.<sup>15</sup> The data also show that in Miami elevated structures experienced a 6.6 percent appreciation. In New York City elevated houses gained even more at a 14.3% appreciation after a major storm. Measures to mitigate storm surge were especially beneficial and associated with a 15.8% rise in Miami-Dade (Kim 2019). These findings comported with studies done elsewhere.

<sup>14</sup> Broward County, the City of Ft. Lauderdale, and the City of Hollywood have also undertaken significant efforts toward mitigation and adaptation.

<sup>15</sup> It should be noted that the category of a hurricane may not be as predictive of the damage it causes as the speed, track, vulnerabilities of the area it impacts. Hurricane Sandy had lost its hurricane status by the time it made landfall in New Jersey in 2012, but with a direct hit on the NYC metro area and a 14-foot storm surge the level of damage was catastrophic.



Jin et al. (2015) found that single-family private houses located within 160 feet of a protective seawall enjoyed a 10% price increase. Turning to commercial property, Fell and Kousky (2015) showed levee-protected buildings sold for approximately 8% more than similar properties without such protection.

More surprising were the benefits to be gleaned from “green resilience.” Measures of this kind in Miami-Dade showed that houses located within 400 meters of green infrastructure enjoyed a 9.7% increase in price appreciation (Kim, 2019:3). While much under-appreciated and often unseen, improvement to drainage also had a positive effect on overall housing conditions. The broader panoply of green infrastructure (beach nourishment, wetlands preservation, swales, berms, parks, recreation areas) yielded larger benefits for the environment by way of reductions in greenhouse gases and an area’s ability to withstand storm surge (Platt, 2013).

In reviewing the evidence, what comes through is that adaptive measures bear a more direct and more substantial relationship to house price appreciation than do locational factors like ground elevation (discussed earlier). Severe hurricanes do deter capital investment and because of this fact adaptive measures are especially beneficial for start-up businesses and new employment opportunities. Certainly, berms and beach nourishment are essential to tourist business, while offering the advantages of cleaner air, less waste, reduced energy costs, and more attractive landscapes.

The question is how do we put these measures into motion? The effective execution of any plan requires complete and accurate data that can be organized and understood by all stakeholders.

In regard to data organization and presentation, FAU’s Center for Urban and Environmental Solutions (CUES) has assembled and curated a collection of web-based planning tools for decision makers and the public, enabling stakeholders to evaluate SLR risk, urban livability, and quality of life (Center for Urban and Environmental Solutions, n.d.) One key tool is the Sea Level Sketch Planning Tool, developed by the University of Florida’s GeoPlan Center University of Florida (<https://sls.geoplan.ufl.edu/>, n.d.). The technique is specifically designed to help identify and highlight transportation infrastructure that is vulnerable to current and future flooding. Other tools in the CUES collection include material developed by federal agencies such as the National Oceanic and Atmospheric Administration (NOAA) and the Environmental Protection Agency (EPA) for evaluating climate impacts on specific assets. Still needed are techniques that allow us to envision different land use scenarios that facilitate best possible choices. We should also investigate programs that allow citizens and decision makers to conduct cost-benefit analyses for investment strategies.

# Urb

## **How do We Organize for Cooperation?**





Coordinating and cooperating on climate policies is in the economic interest of citizens, stakeholders, and government officials. The Southeast Florida region enjoys the advantage of already having begun those efforts through the Southeast Florida Regional Climate Change Compact. Established ten years ago by four counties, the Compact created a platform allowing its members to initiate policies aimed at adapting to weather impacts.<sup>16</sup> Toward this end, the Compact developed a Regional Climate Action Plan (RCAP). The RCAP, now in its second generation (RCAP 2.0), created a series of high-level recommendations intended to drive local planning. Among its most significant achievements is the development of a coordinated baseline containing SLR projections for different parts of the region. This kind of shared data is critical for a coordinated approach to planning.

While the Compact and RCAP were major steps forward, the time has come to strengthen those initiatives. The Compact's major shortcoming lies in its fundamental design as an advisory body and its lack of delegated authority to make enforceable, binding decisions. The absence of that authority makes it harder for the Compact to act as a unified body and realize policies that can bring about tangible and achievable objectives. Rather, the Compact is a voluntary organization that relies on the willingness of each member to work with one another under a rule of unanimity. While members have a common interest in adopting regional policies, they also have differing shorter-term interests that can compromise that very objective. This is particularly valid for the very important issue of land use. Thus, it may be in the interest of the larger region to set aside flood prone land from development, but a locality may instead seek to develop that land because of possible gains in tax revenue.

As we might discern from this example, the Compact is not always able to treat South Florida as a holistic, commonly shared entity. Storms and water do not follow local political boundaries. Rather, they flow along the contours of natural geography and onto a much larger expanse of land. There are also instances where localities cooperate with one another through inter-local agreements. Miami-Dade County partnered with the cities of Miami and Miami Beach under the 100 Resilient Cities program to develop a resilience strategy for "Greater Miami and the Beaches."

*The Resilient 305 Strategy*, published in 2019, is another strong example of jurisdictions working together to coordinate adaptation efforts.<sup>17</sup> But like the Compact, these are voluntary partnerships and are only as effective as the local willingness to work together.

Besides, there are distinct benefits to developing a region-wide institution. The current system operates within a framework of a zero-sum game, where each party becomes absorbed in how a decision affects its individual constituents rather than the cumulative benefit across the region. Achieving a consensus requires that each party be awarded short-term parity benefits. By contrast, a regional institution possesses a greater ability to balance local benefits over a longer-term. Accordingly, it can entertain solutions that may offer greater and more equitable benefits across a wider geographic scale, while also distributing that benefit to localities sequentially and over a long-term. Finally, the presence of a regional institution discourages private sector parties from drawing localities into "venue shopping," thereby pitting one jurisdiction against another in an effort to attract private investors. Too often the upshot exacts unfair concessions from a "winning" jurisdiction where every locality loses in a process criticized as "a race to the bottom."

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<sup>16</sup> 35 of the municipalities within the four counties have signed the Mayor's Climate Action Pledge in support of the Compact and the RCAP. A list of the signatory municipalities is available at: <http://southeastfloridacclimatecompact.org/about-us/what-is-the-compact/>

<sup>17</sup> For details see <http://resilient305.com>

# How do We Organize for Cooperation?

## 06

A number of regional models exist, all of which have been tried elsewhere, that would provide South Florida with an ability to adopt more effective climate policies (Savitch and Vogel, 2010). Some are more singularly directed toward region-wide protection, others provide a compromise between regional and local interests, and still another favors local interests, but provides some outlet for regional solutions. Some are imposed top-down policies, others strike a balance between central authority and local interests, and others are more attuned to local interests, but contain a “regional option.” We offer these as “ideal types” to stimulate thinking about the institutional possibilities for carrying out regional climate policies (Weber, 1946). Their organizational elements can be modified, eliminated, substituted, and transferred from one typology to another. Further, we treat these as a continuum ranging from the most authoritative region wide institution to a more locally oriented body.

The key to understanding distinctions within these typologies depends upon: Where does power lie within the organization? Who chooses the organization’s membership, as elected or appointed and accountable to whom? What is the extent of its binding authority? And, whether its source of funding is derived from a separate revenue stream, allocation from general taxes or other means? Table 3 displays the major feature of each model together with examples (by start-up years).

In setting forth these models, we recognize that much of the research on this subject strikes a cautious, if not skeptical note about governments’ ability to organize individuals for cooperation (Ostrom, 1990). Game theory, so well-illustrated by “the Prisoner’s Dilemma,” uncovers the paradox that the pursuit of individually rational strategies negates the chances of achieving

collective, beneficial outcomes. Therein lies a serious contradiction between what a locality sees as its well-being versus how a larger region might conceive its own needs. Long ago Olson (1965) showed the difficulty in getting individuals to mobilize for what has come to be known as “collective action.” On the back of the “collective action” problem, Hardin (1968) pointed out that “common pool resources” are invariably exploited and ultimately exhausted by individual rational users. As the dictum goes, “everybody’s property is nobody’s property” and “wealth that is free for all is valued by no one.” That said, there are ways of getting around impediments to “collective action”—most commonly by the imposition of an external authority (coercion) or by a variety of inducements—“sweeteners” for cooperating parties in the form of state subsidies or “side payments” made for achieving specified results. We should keep these in mind as we describe our models.

**Top Down/Region Centered, state-imposed agencies** are often introduced to resolve a crisis or failure in local government. New York State’s Urban Development Corporation (UDC)<sup>18</sup> came into being because the city had neither the resources nor the will to provide affordable housing. Years later the state imposed other ruling bodies on the city because of its fiscal collapse. A similar incident occurred in Detroit, when that city fell into bankruptcy and the state imposed its own rulership. Given these precedents, it is not farfetched for the state of Florida to take similar action in a climate emergency. The state could establish an agency to carry out eminent domain proceedings and purchase land in areas of recurrent flooding or mandate special requirements for new houses (elevated, dry-proofed, wet-proofed). After Hurricanes Katrina and Rita in 2005, Louisiana created the Louisiana Recovery Authority (LRA), which had the responsibility for administering over



**TABLE 3**

Models of Planning Organization for Climate Adaptation in South Florida

REGIONAL		LOCAL	
TOP DOWN REGION CENTERED	MIXED MULTI -TIERED	MIXED COMPLEX NETWORK	BOTTOM UP MODIFIED COMPACT
State-Imposed Agency	Separate Tier of government (territorial based)	Collected jurisdictions (task based)	Existing county members
Appointed Members	Elected across region	Appointed from multiple localities	Major officials ex officio.
Authority by fiat to override local decisions (subject to hearing & appeal)	Majority voting for binding policies	Super majority vote for binding policies (climate adaptation)	Binding policies for narrow special purpose
Funded by state appropria- tions and bonds.	Funded by revenue raising capacity (separate revenue stream)	Funded by allocation from general tax funds or federal funds provided to the region	Funded by add-on or special tax.
New York's Urban Develop- ment Corporation (1968)	Minneapolis-St. Paul (1967)	Metropolitan Planning Or- ganizations (MPOs) (1962)	Louisville Compact (1986)
Detroit, State Oversight Team (2013)	Portland (1979)	Lyon (1967)	Pittsburgh Alleghany Regional Asset District (RAD) (1993)
	Dutch Waterboards (13th century)	Marseille (2000)	
	London (1999) Tokyo (1943)		

# How do We Organize for Cooperation?

## 06

\$10 billion in federal recovery funding. However, while the LRA provided funding, they did not take on land use decision-making powers but worked with local governments. The realization of this alternative should be a prompt for localities to adopt their own organizational measures. The drawback of this measure is political. While state-imposed agencies have been very effective, they are by nature undemocratic and prone to take arbitrary measures. For this reason, they tend to be short-lived and designed for a single purpose, though New York's UDC has gone on to enjoy permanency as a major developer. UDC has also created sub-agencies (instrumentalities) such as the Lower Manhattan Development Corporation (LMDC) after the terrorist attacks of September 11, to manage the recovery and rebuilding of Lower Manhattan. The LRA lasted for 5 years and sunset in 2010.

**Mixed, Multi-tiered organizations** establish a formal overlay of authority atop existing jurisdictions. The idea is to create an "umbrella level" of policy making that covers localities within a specified geographical region, such as many of the port authorities in Florida, which have their own elected boards. As such, it is territorially based and deals with problems in that context. Seen another way, multi-tiered governments do not so much establish a distinction between "lower levels" or "higher levels" of authority but create tiers of government that deal with "narrow issues" as well as "wide issues" (like climate adaptation). Direct region-wide elections are intended to get the electorate to think regionally and impart the umbrella tier with democratic legitimacy. An independent revenue stream also enables this wider tier to be especially vigorous in climate protection. In some cases, the multi-tier works well (Portland,

Vancouver). The Netherlands' highly touted water boards (Waterschappen) are directly elected and serve as umbrella units in localities all over that country. In other places multi-tiered organizations have failed and been abolished (Toronto, Rotterdam, and Barcelona). The metropolitan tiers in Minneapolis-Saint Paul, begun in 1967, has encountered difficulties but survives to this day. While multi-tiered organizations may appear to have reached a happy medium by combining localism with regionalism, they do arouse political foes. The umbrella tier has found itself caught between one kind of resentment at the top and another antipathy at the bottom. At the top, state officials look down at umbrella policy makers who compete with them for sizeable constituencies and cut into potential tax revenues. At the bottom, localities look up at the umbrella and dislike being told they must accept restrictions on waterfront development or build high dunes that block ocean views.

**Mixed Complex Networks** is a method of "collecting" many localities and forming an assemblage of cooperation. The idea: once localities are put together; they will work together. Unlike its multi-tiered cousin, complex networks (organizations) do not warrant an additional layer of government. Rather, they work by keeping localities intact and by incorporating sitting officials, across jurisdictions into decision-making circles. These collections of localities may focus their activities within "special districts." This kind of complex organization emphasizes informal, horizontal lines of collaboration, self-regulation and market-oriented policies (carbon taxes instead of bureaucratic controls). Regions may have multiple, unidentical and different groups organized around different regional problems (transportation, workforce training, climate protection).

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<sup>18</sup> Often co-branded as the Empire State Development Corporation (ESDC).





The network is geared to task rather than territory. Its advantage lies in its durability because its office holders are in charge of the same departments and units that are tasked with a new mission. This very same quality poses the disadvantage of empowering the same local interests that require change and broadening. Metropolitan Planning Organizations (MPOs) are a form of complex network and have a history of resilience, mainly because they pay for their own services and offer access to federal funds for transportation. Other complex organizations have remained fairly stable and are prone to preserving the status quo.

and its promise of realistic adoption. Its limitation may be that it is too cautious about bringing about institutional change. However, we should note that a modified compact provides more ability to make binding decisions than the advisory compact structure of the Southeast Florida Regional Climate Change Compact discussed earlier and the recently formed Tampa Bay Regional Resilience Coalition. Without the ability to bind, effectiveness of the structure may be compromised when the issues are highly complex or controversial.

**Bottom-up Modified Compacts** are similarly configured as existing compacts. The big difference lies in the extension of their advisory role into binding and enforceable policy actions, albeit with the need to garner super-majorities of two-thirds or three-quarters (in contrast to a simple majority of 51 percent). The idea is to increase the chances of organizing and enhancing region-wide cooperation. Compacts are capable of evolving, so the argument goes, and why not take a familiar organization and allow it the discretion of making binding decisions. We can also view the formative years of a compact as a confidence building measure that permits the public to understand the benefits of inter-local cooperation as well as its necessary expansion. Louisville experienced this evolution, as the public came to see the benefits of tax and function sharing between city and county.<sup>19</sup> Pittsburgh's Regional Asset District (RAD) has also proven its worth over the years and is today a permanent fixture of that region's landscape. Both of these compacts were popular enough to draw on special (county-wide) taxes. The advantage of a modified compact lies in its less threatening profile

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<sup>19</sup> After 12 years of a Compact Louisville consolidated with its surrounding county. At least some felt an extension and expansions of the Compact would have been a better solution than city-county consolidation. See, H.V Savitch Ron Vogel and Lin Ye, "Beyond the Rhetoric: Lessons from Louisville's Consolidation" *The American Review of Public Administration*, 2010; 40; 3

# 07

## What can We Conclude?



While SLR is now recognized as a serious problem in South Florida and reflected in the pricing of some properties at near term risk, it has not been commensurately reflected in all house prices. This is stated as a discrepancy between expressed preferences (voiced intentions) and revealed preferences (actual behavior). To some extent the gap may stand in the way of fully organizing localities for cooperation on climate change. Nevertheless, the vulnerabilities are real and pushed along by warning signs (street flooding due to King Tides, greater storm flooding, and saltwater intrusion). Of all the regions in the United States, South Florida is especially at-risk. A good deal of the ongoing research has focused on Miami-Dade and the Florida Keys. Localities within Miami-Dade have already begun to act, mostly through hard engineering but other techniques, considered as “green infrastructure”, are gradually taking hold. The Florida Keys seems to be lagging behind its ability to deal with gargantuan problems and, if not enough is done soon enough, the island chain could face an irrevocable pattern of inundation by 2040 or 2050.

We also acknowledge a shadow of a threat in “climate gentrification,” a condition explained by researchers where property buyers choose safe locations on higher ground. Are we on the precipice of a mass migration, away from coastal communities? Thus far, this has not occurred nor is there any sign of it, though some researchers point out it would not happen until the end of the century (Hauer et al, 2017). It is also unclear if the primary and secondary impacts of climate change will make some of the receiving communities less hospitable. No area is likely to escape the direct or indirect effects of climate change.

Still, we have any number of choices to protect ourselves from weather hazards. Doing so requires that we organize localities for cooperation. We should start with accurate and understandable information that can be conveyed to all stakeholders. There are also planning

tools at our disposal; one of the most salient is the Sea Level Scenario Sketch Planning Tool available from the University of Florida GeoPlan Center (<https://sls.geoplan.ufl.edu/>.) A number of agencies also collect data and provide techniques for evaluating climate impacts, such as the NOAA and EPA. Also important is the need to develop scenarios of weather threats and how localities might respond to those challenges. A number of tools are available (e.g., <http://cues.fau.edu/planningtools/>) to assist planners, but more training for decision-makers and stakeholders is needed on how to use and interpret the data they provide.

Finally, South Florida needs to find an organizational path for making binding, enforceable decisions. We suggest four typologies by which this can be pursued. The typologies resemble modules, whose components can be modified, eliminated, substituted and transferred from one another. They vary along a continuum that takes into consideration the structure of authority as well as a balance between regional and local interests. These include a 1) a top-down region centered organization 2) a mixed, multi-tiered system that balances region and locality 3) a complex network that also balances region and locality, albeit in a different way and, 4) a bottom-up, modified compact that favors local interests, but still allows for binding, enforceable decisions. While the compact option has been embraced in Southeastern Florida, it lacks the capacity for the coordinated and binding actions required to meet the SLR crisis.

In the final analysis, the opportunity is here and now. We still have a few decades to organize and respond to SLR. However, the longer we wait the more difficult it becomes to protect our low-lying and most vulnerable coastal communities.



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