

# SEA LEVEL RISE SUMMIT

## RESILIENCE IN THE FACE OF CHANGE



### SEA LEVEL RISE SUMMIT 2013

### FINAL REPORT

Prepared by the  
Florida Center for Environmental Studies (CES)  
at Florida Atlantic University

*The Sea Level Rise Summit 2013 was coordinated by CES &  
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## EXECUTIVE SUMMARY

On October 16-17, 2013, Florida Atlantic University's (FAU) Center for Environmental Studies (CES) hosted its 2nd Annual Sea Level Rise Summit, *Resilience in the Face of Change*. Events held in downtown Fort Lauderdale included two full days of exceptional speakers and panel sessions, important keynotes, two screenings of the film *Shored Up* and a Sea Level Rise Adaptation Workshop on Friday, October 18. The Summit was held in partnership with the [Association of Collegiate Schools of Architecture's Subtropical Cities Conference](#), which took place October 18-19. Focusing on the impacts on the economy, health and built environment, the Sea Level Rise Summit addressed issues that professionals, local governments and communities face in adapting to sea level rise and other climate change related impacts. Local, national and international experts demonstrated best practices and state of the art research focusing on the needs of those planning for our collective future.

In 2012, CES Director, Dr. Leonard Berry, testified to the U.S. Senate Committee on Energy and Natural Resources on Florida's vulnerability to sea level rise. At that time, the general public was less aware of these vulnerabilities. Since then, Superstorm Sandy has put the risks relating to sea level rise in the public eye, making headlines in the New York Times, USA Today, National Geographic and many other major national and international media outlets.

President Obama's Climate Action Plan punctuated a growing desire to put research into action. With the recent release of the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report, it is important to consider the sea level rise implications for vulnerable South Florida. Newly emerging science on glacier and ice sheet melt, combined with the lessons learned from Sandy, has brought a greater sense of urgency to climate change issues.

The latest IPCC report states that global sea level has risen 19 cm (7.5 inches) between 1901 and 2012, and that the rate has accelerated to 3.2 cm per decade in the last twenty years, matching tide gauge and satellite observations. South Florida remains one of the world's most vulnerable regions to sea level rise and climate change. We have so many questions that still need to be answered. What should we do to manage an uncertain future? How can we reduce impacts, maximize opportunities and become more sustainable in a changing and uncertain world?

The Summit brought together a broad community of stakeholders to help answer these driving questions. The following report provides an overview of the projects and research presented during the Summit emphasizing the economic, health, and urban design issues important to South Florida on local, national and international levels.

Below are the goals from each panel session:

### **Session 1: Sea Level Rise & Storm Surge: A Damaging Combination**

- Take stock of our scientific knowledge of sea level rise, understand storm surge and its damage on natural and built environments, and examine possibilities for collaboration between scientists and design professionals for the adaptation and resilience of vulnerable communities confronted with the dual threat of sea level rise and storm surge.

### **Session 2: Adversity, Opportunity & Resilience: Economic Implications of Sea Level Rise**

- Examine the economic impacts of sea level rise with a focus on the power, insurance and real estate industries and explore opportunities for businesses. Examine issues arising from environmental uncertainty confronting government, business and society. These include the rising costs of mitigation and adaptation, as well as economic sustainability.

### **Session 3: Integrating the Health Impacts of Sea Level Rise into Resiliency & Adaptation Planning**

- Identify on-going efforts and gaps in understanding the health impacts of sea level rise and provide perspectives from local, state and federal partners while illuminating the need to increase community resilience.

### **Session 4: Impacts on the Built Environment – Facing a New Design Paradigm**

- Examine the issues facing aging and/or vulnerable public infrastructure such as roads, utilities, electrical grid, water and waste management and explore new approaches to design thinking that should drive decisions in the immediate, near, and long-term future. Explore the needs of architects, planners and others charged with designing the built environment in the face of sea level rise and other climate change related impacts.

### **Session 5: Adaptation, Innovation & Resilience on a Local, National & International Front**

- Identify a potential adaptation strategy tool kit for Florida and by extension similar coastal areas nationally and globally. Develop a concise set of recommendations for mitigation and adaptation approaches and priorities aiming at truly sustainable adaptation, linking local experience with insights from our international experts.

## **WELCOMING REMARKS**

Fort Lauderdale's **Mayor John P. "Jack" Seiler** welcomed participants and introduced Fort Lauderdale as the Venice of America. At ground zero for vulnerability to sea level rise, the city is already seeing impacts. The mayor described high tides and erosion from Sandy that required them to rebuild a section of State Road A1A (**Figure 1**). He pointed out the economic benefits of investing in shoreline renourishment, prompting its integration into Fort Lauderdale's five and thirty-five year plans. The city's plans also include a focus on expediting recovery and enhancing the city's resiliency and sustainability.

Following the Mayor, **Dr. Leonard Berry** agreed that Sandy was a wake-up call that moved sea level rise from the periphery to a front line issue. He emphasized that the Summit would focus on adaptation, but stressed that we must first understand the science. A goal of the Summit was to identify new sea level rise related research, projects and programs and explore issues needing further research.



**Figure 1.** High energy waves damage beach, seawall, and road in Fort Lauderdale (Nov 2012, Keren Bolter)

## KEYNOTE SPEAKER

Architect **Elizabeth Plater-Zyberk** began by reading a quote from Jeff Goodell’s June 2013 *Rolling Stone* article noting that “if sea-level rise happens slowly enough, the City of Miami may well have the time to transform itself into a modern Venice.” While this controversial “Good-bye Miami” story is criticized for its doom and gloom undertones, it did conclude on a positive note saying that South Florida *can* deal with sea level rise. The question is *how*. In the context of the public/private interface, where and how do we spend the money? It is important to embrace sound science and keep it evolving, but also to think ahead about challenges and opportunities. What is important to us will not necessarily be important to rest of the country, and therefore we need to focus on our regional impacts and needs. Plater-Zyberk indicated that the two main effects of climate change in our region are flooding and storm surge. **Table 1** lists the options for protection from these impacts. Other regional sea level rise impacts include saltwater intrusion into aquifer/wellfields, beach erosion, the rise of inland waterway levels, storm water system inadequacy, coastal and inland inundation and coastal wetland migration.

**Table 1: Options for protection from two key sea level rise impacts**

Storm surge protection	Flooding protection
Mangrove replenishment & restoration Beach replenishment Sea walls & rip-rap Levees Flood gates Pumps Reinforcing bridges	Increase surface storm water storage Xeric parks and streets Stormwater injection wells Backflow preventers (bayfront) Elevation of land - streets & buildings Depaving – increasing permeability

Plater-Zyberk asked, “What makes sense where? Where do you spend money to do something major to fortify a place? Can you use the land for something else once it’s lost?” To answer these questions, we need to look at the different types of vulnerabilities (**Table 2**) and identify priorities through geographic and economic considerations (**Table 3**).

**Table 2: Adaptation Vulnerability Framework**

	Adaptation vulnerability type			
	Infrastructure	Buildings	Natural Environment	Regional Networks & Systems
Main Sector	Public	Private	Public	Public
Main Components	<ul style="list-style-type: none"> <li>- SFWMD: canals, gates &amp; pumps</li> <li>- WASAD: pipes, pumps &amp; lift stations</li> <li>-FDOT/MDTA: highways, bridges, &amp; causeways</li> <li>Public Works: roads &amp; bridges</li> <li>- FPL: electrical grid</li> <li>- Communications</li> </ul>	<ul style="list-style-type: none"> <li>- Government</li> <li>- Institutional</li> <li>- Commercial Office</li> <li>- Retail</li> <li>- Housing (single/multi-family)</li> <li>- Industrial</li> </ul>	<ul style="list-style-type: none"> <li>- Ecology (mangroves, beaches, reefs &amp; other habitats)</li> <li>- Water supply (aquifer/desalination)</li> <li>Water bodies</li> <li>- Conservation lands (Everglades, EEL)</li> </ul>	<ul style="list-style-type: none"> <li>- Development patterns: geographic consolidation</li> <li>- Transportation</li> <li>- Agriculture</li> <li>- Parks</li> </ul>

**Table 3: Factors impacting sea level rise response decision path**

<b>Geographic</b>	<b>Economic</b>
Inundation areas Frequent Flooding areas High and Dry Ground	High Investment (density, age) Low Investment (density, age) Socio-Political Priority (historic sites, community identity)

Plater-Zyberk said we need courage to deal with these issues. How do you deal with economic priorities? The financial considerations of private property ownership should address what happens to the land once it has been submerged, a hard concept to talk about. We are already adapting, but we can do a better job of warning people. She also illustrated several student projects that found creative and innovative designs with the changing shoreline (**Figure 2**).



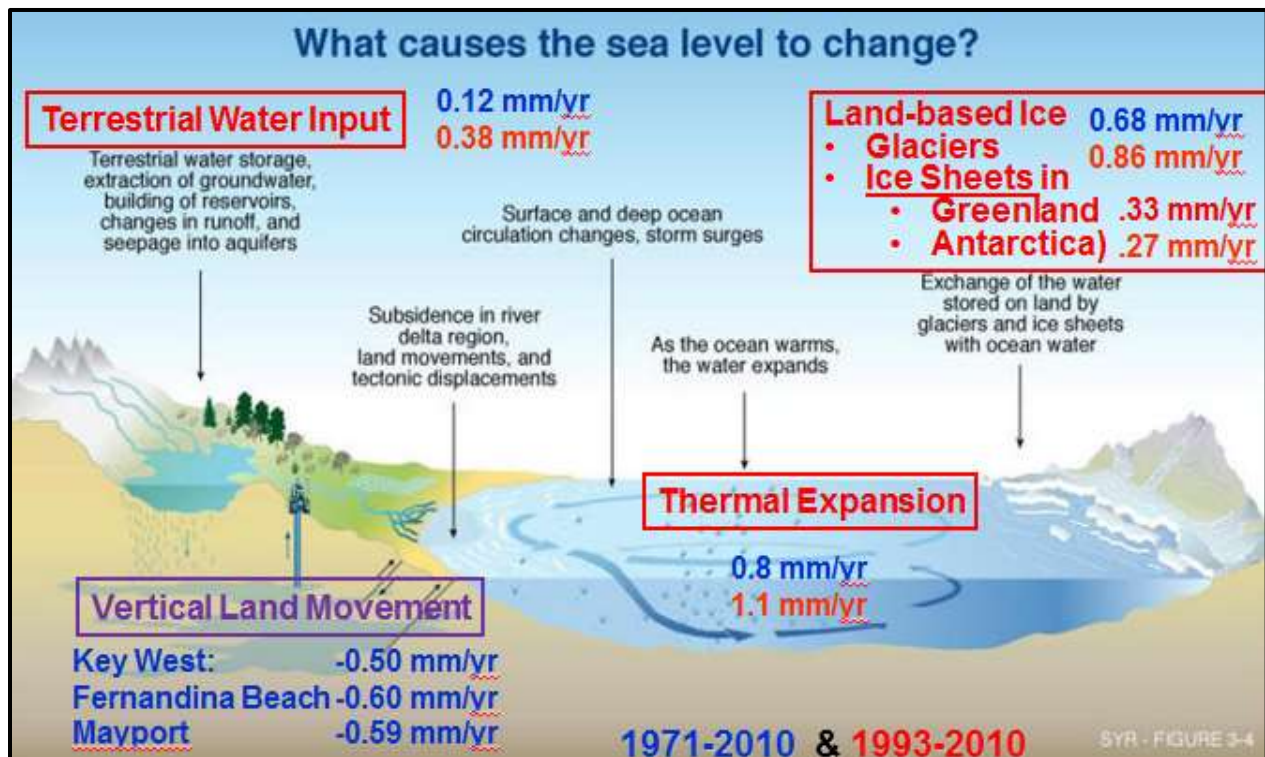
*Figure 2 University of Miami School of Architecture Research & Design Studio Fall 2008. Project by Brian Lemmerman – Stanley Key & The New Georgia.*

## **SESSION ONE: SEA LEVEL RISE & STORM SURGE: A DAMAGING COMBINATION**

### **Part 1: Sea Level Rise & Storm Surge, the Florida Model**

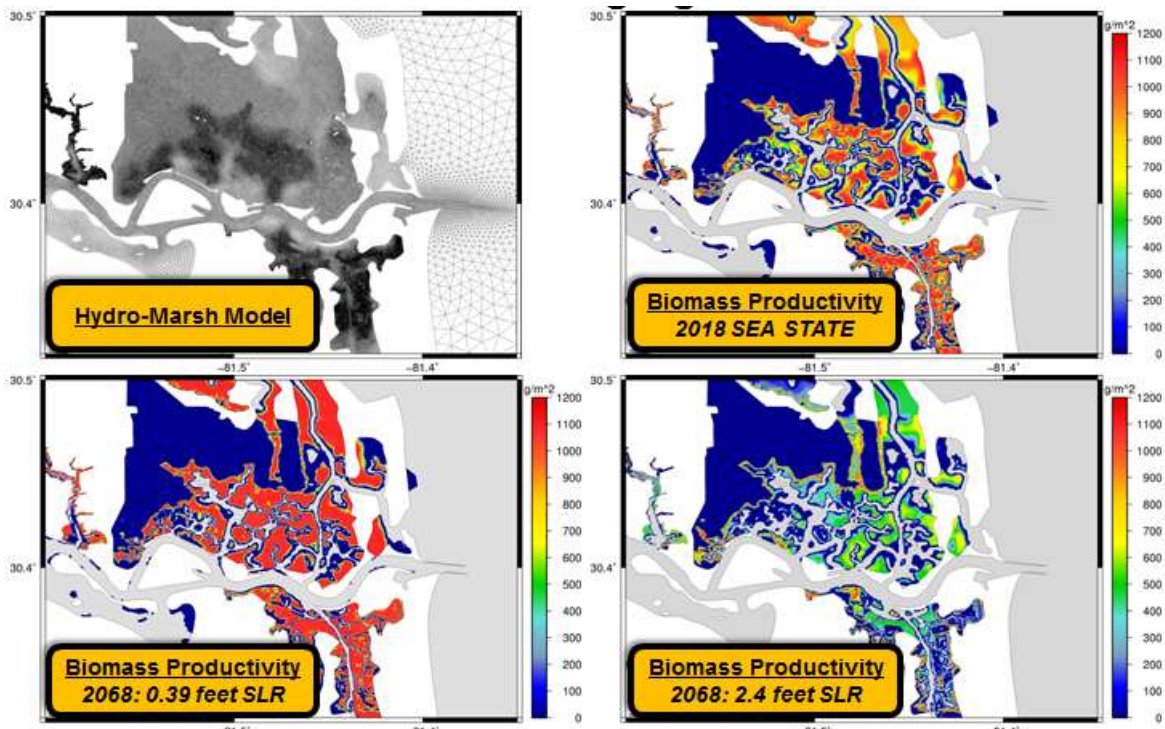
Moderator **Ricardo Alvarez** introduced the session’s three goals: (1) to take stock of the state of our scientific knowledge relative to current and projected future rates of rise; (2) to focus on storm surge, its exacerbation by sea level rise, current and expected impacts and potential for damage on natural and built environments; and (3) to recognize that collaboration between scientists and design professionals, such as architects and engineers, is vital for the adaptation and resilience of vulnerable communities confronted with the dual threat of sea level rise and storm surge.

Panelist **Jayantha Obeysekera** introduced the scenario planning methodology that uses high, mid and low projections to manage risks. **Figure 3** shows how each contributing factor to sea level rise has changed in two recent time periods: 1971-2010 and 1993-2010. Additionally, it was noted that there is land movement in Key West that slightly decreases the relative sea level rise rate by 0.50 mm/yr. Obeysekera explored how the science can be applied to water management. Broward and Miami Dade County’s water structures are vulnerable to sea level rise as some structures cannot handle current and projected changes in sea level. Everglades restoration planners must decide to restore or place a greater emphasis on hydrological changes. The lower elevations in the southern Everglades will be flooded by increased sea level rise. Should we abandon the restoration because it will be underwater? Is this restoration now even more important, as peat accumulation that may prevent freshwater marsh collapse? Can peat accumulation keep up with the rate sea level rise?



**Figure 3** Global and relative sources of sea level rise.

Panelist **Scott Hagen** pointed out that with rising sea levels, the best that we can do now is to “manage the unavoidable and avoid the unmanageable.” He asked, “How much are we willing to spend in next 45 years?” Tidal wave processes and the crest and falls of the waves need to be included in sea level rise models. With a small amount of sea level rise over time, marsh productivity can be enhanced, but higher sea level rise over 50 years decimates that marsh. A dynamic approach is needed. Urban locations will experience changes and barrier island evolution will be more dramatic as sea levels rise. Solving future problems requires a multi-disciplinary approach. Hagen’s dynamic process is based on a “Tide, Wind-Wave and Surge Modeling Framework,” which is applied to a portion of the Gulf Coast. Initial model results for Jacksonville show that sea level rise is more impactful to local salt marshes than channel dredging (**Figure 4**). The impacts of a few millimeters of rise per year are hard to understand, but increasing wave height is easier to visualize. Slow moving water will cause much more damage than fast moving wind. How do we communicate these impacts in a meaningful way to the decision makers, the public and those designing our communities?

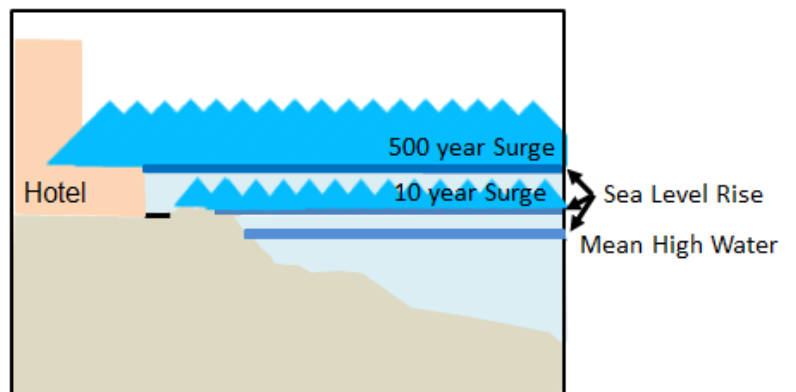


**Figure 4.** Assessment of Jacksonville Harbor Project with projected sea level rise scenarios

## **Part 2: Communication and Collaboration**

Ricardo Alvarez explained how 2 - 3 mm of sea level rise per year combines with storm surge, and height of waves, which are both depth dependent. Higher water levels will mean higher waves, strengthening storm surge and increasing its impacts which will result in greater damage. Panelist **Hugh Gladwin** explained that the complex interactions in the built environment make storm surge and rising seas difficult to manage. Miami-Dade County has created new evacuation zones that extend to the western edge of the county. Risk assessment challenges include balancing the cost of evacuation with the loss of life. According to a study on Superstorm Sandy, most people did not understand the life threatening potential of storm surge until after the storm, when infrastructure was destroyed or seriously compromised. We need to translate risk assessment in a way that the public can understand so they can better prepare for storm related emergencies.

Panelist **Samantha Danchuk** used Fort Lauderdale’s beach to illustrate the potential increase in flooding and wave damage resulting from the combination of storm surge and sea level rise (**Figure 5**). During a ten year storm event, storm surge drives the water level up a few feet. A 1.5 foot rise in sea level allows flooding over the back berm and results in waves reaching the road and adjoining promenade infrastructure. During a 500 year storm event, the surge level more than doubles and waves flow over the first and second floors of structures, leading to severe damage.



**Figure 5.** Increased risk of flooding and wave damage from sea level rise



Danchuk pointed out her reliance on analytical models in vulnerability analyses. With her firm, she has designed several barrier islands in Louisiana that consider sea level rise. They use numerical and analytical models to determine the amount of advanced fill required and dune height necessary to sustain the island. By modeling every storm over the last 75 years with historic, intermediate, and higher sea level rise scenarios, the best strategy for restoring and maintaining the dunes over 20 years can be identified. A recent study funded by NASA aims to provide decision making support for the restoration of beach and dune systems in a way that addresses climate change impacts and outlines adaptation for the future. Beach nourishment is an adaptable strategy as long as sea level rise is incorporated.

Panelist **Caroline Lewis**, Director of the Miami-based CLEO Institute, emphasized the need to increase our communication and outreach efforts to the public and lectures throughout Florida and nationally on climate change issues and engagement. She stressed the need for multiple access points in order to reach broader audiences and encouraged those in attendance to get involved “We must promote, provoke, and celebrate engagement by disengaged people.” Her motto is ‘don’t throw up your hands, roll up your sleeves’ and stressed that we need to bridge the divide between science and society and to open up our spheres of influence.

Panelist **Tommy Strowd** described the logistics of water management in preparation for the predicted increases in sea level and stressed that various flood control structures in Miami-Dade and Broward Counties are already at risk. As a result, a spillway in Miami had to be adapted with a pump station because it failed to drain inland floodwater (**Figure 6**). By understanding the risks and planning for improvements, we can increase the life of our infrastructure. These won't be ultimate solutions, but incremental steps towards the solution.



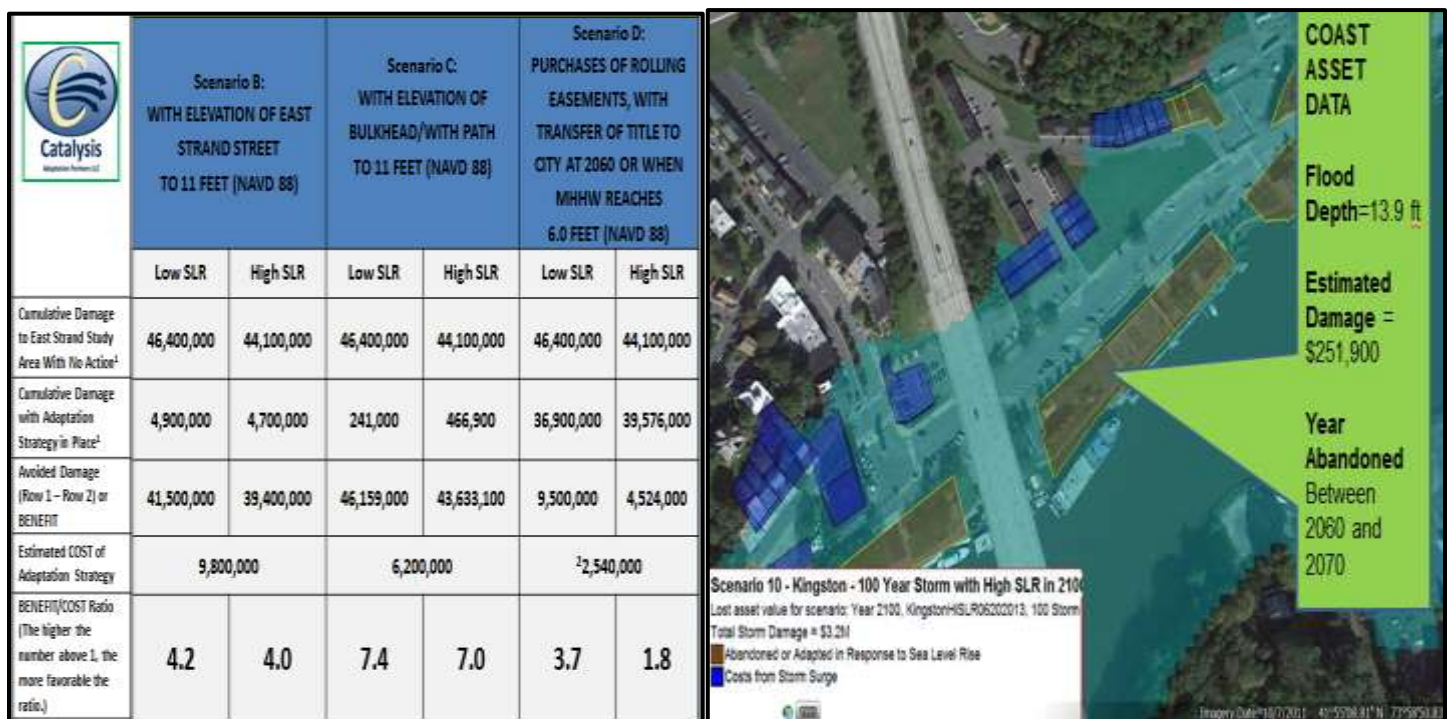
**Figure 6.** Adapted flood control structure in Miami-Dade County.

Panelist **Thomas Ruppert** discussed a crucial aspect of adapting to sea level rise: the human element. Acting on adaptation to sea level rise is not just a technical problem, it is a people problem. We need to inform and engage property owners, businesses, voters and taxpayers and get them involved enough to act without risking overwhelming them into a state of inaction. Sea level rise in the context of flood insurance may be the answer. We have gotten better at understanding flood risk. But last year, the IPCC noted increases in losses from disasters, not due to sea level rise, but rather from exposure, because we continue to build and invest in vulnerable coastal areas. It is also a political problem involving subsidies to insurance companies. The voting public needs to take leadership and communicate with lawmakers. As a state, we need to do a better job acting on the data that we already have.

## SESSION TWO: ADVERSITY, OPPORTUNITY AND RESILIENCE: ECONOMIC IMPLICATIONS OF SEA LEVEL RISE

Moderators **Julia Higgs** and **Mantha Mehallis**, of Florida Atlantic University, highlighted the need for identification and disclosure of assets at risk, not only for sound investment, but also for mitigating possible impacts from tax base changes. Insurance providers have already started incorporating increased risk to premium calculation methods for property, and bond agencies and mortgage backers may soon follow suit. The new costs may disproportionately impact smaller communities unable to provide the resources to mitigate the impacts of sea level rise. Solutions may have to contend with movement of capital and residents to less risky areas.

Panelist **John Lockman** presented a case study of Kingston, NY which demonstrated one city's approach to identifying impacts, along with presenting mitigation and adaptation solutions (**Figure 7**). The COAST model of the potential costs of sea level rise over a hundred years was used to provide a cost/benefit analysis to defend, accommodate, or retreat from impacted areas. By providing this information to the community, they were able to implement solutions at an appropriate and manageable scale.



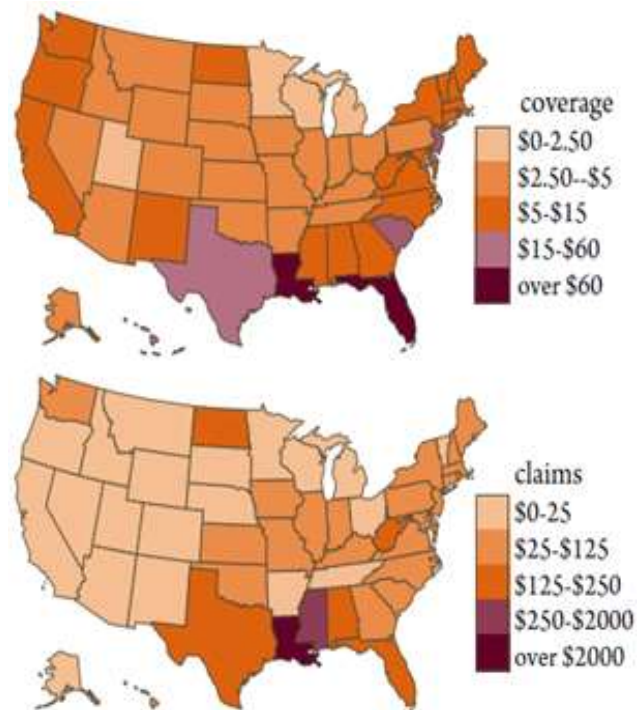
**Figure 7.** COAST tool comparing the benefits of adaptation costs of damage from surge and sea level rise.

Panelist **Jeff Williams** provided an example of how private industry is incorporating sea level rise risks into their long term planning. Entergy, a major energy provider in Louisiana, contends with hurricanes, storm flooding, and erosion while providing power to Port Fourchon, the nation's busiest intermodal energy port. These challenges led to incorporating sea level rise into long term planning to better provide uninterrupted service. However, merely improving electrical infrastructure proved insufficient to maintaining operations at Port Fourchon; it required joint solutions of government, business, and communities.

Panelist **Mitchell Chester** described the current challenges in the legal system relating to sea level rise and why addressing these issues is vital to the fair application of laws. For example, in real estate, legal cases involving the sale of properties at risk of flooding show how current contract processes are in need of revision. These cases involve not just the buyer and seller but also the financial institutions providing loans, regulatory agencies responsible for inspections and others. To navigate these complex matters, law schools need to include sea level rise in the curriculum and law makers need to provide clarity for current policies.



**Figure 8.** Citizens handbook for subsidies.

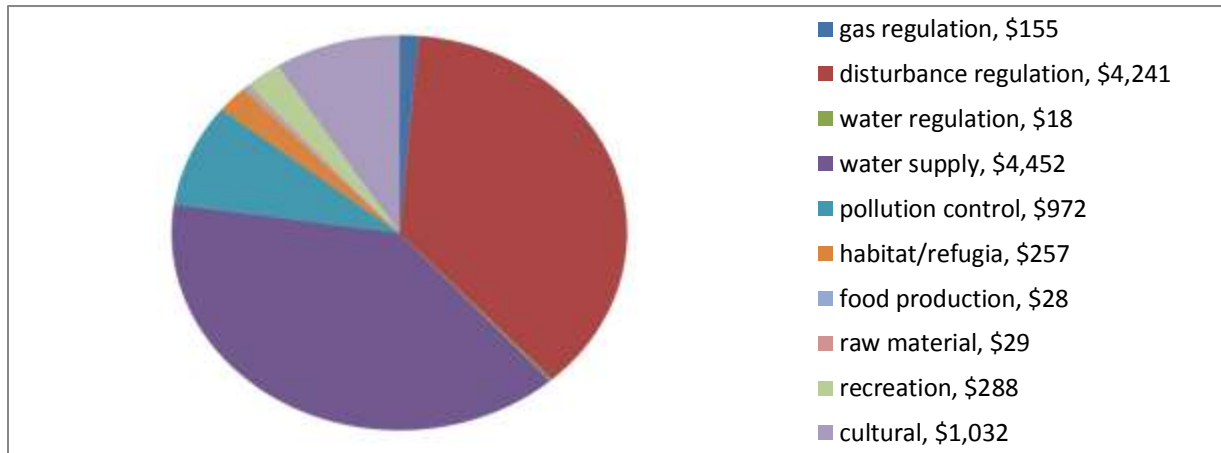


**Figure 9.** Louisiana leads in cost for coverage and claims.

Panelist **Keith McCue** explained that current property insurance programs don't consider sea level rise risks, leading to increases in development in high risk areas. Subsidized policies are priced at 40% of the actuarial sound rate. Through the National Flood Insurance Program, Citizens Property Insurance Company (**Figure 8**), and the Florida Hurricane Catastrophe Fund, the average coastal resident is paying about half of the true insurance costs. The Congressional Budget Office numbers reflect that 40% of coastal properties receiving rate subsidies are worth over \$500,000 and 12% over \$1 million; 23% of subsidized coastal homes are vacation homes. The reduced insurance costs, in conjunction with a desire to develop beachfront property, has increased environmental degradation along coastal areas and in turn increased the potential costs of sea level rise. The cost of coverage and claims varies drastically by state (**Figure 9**).

Panelist **Julie Dennis** focused on the need for assistance in incorporating sea level rise into development plans for Florida coastal communities. The State of Florida has implemented a five-year program that begins with the identification of stakeholders and partners required for successful implementation. During the second year, an intensive vulnerability assessment will determine the scope and scale of impacts using existing tools. The third year focuses on developing adaption and mitigation strategies for the targeted communities with the creation of a Regional Climate Action Plan. The final two years evaluate the effectiveness of the outcomes and process to ensure that any problems encountered are addressed.

Panelist **Sam Poole** provided examples demonstrating the need for redesigning our disaster recovery policies in order to prevent development in sea level rise high-risk areas. In the aftermath of Hurricane Andrew, devastated communities such as Soggy Bay rebuilt with funding through the National Flood Insurance Program even though developing elsewhere would have been more prudent. Similarly, after Katrina disaster recovery programs redeveloped high risk areas in New Orleans' 9<sup>th</sup> Ward district. Policy changes in disaster recovery and insurance are required so that residents are not rebuilding in high risk areas. In addition to high value property and infrastructure at risk, numerous ecosystem services are vulnerable. The Kissimmee-Okeechobee-Everglades watershed has an annual economic value of \$12.3 - \$45.5 billion (**Figure 10**). Well-designed restoration projects can protect these assets as they are threatened by rising sea levels.



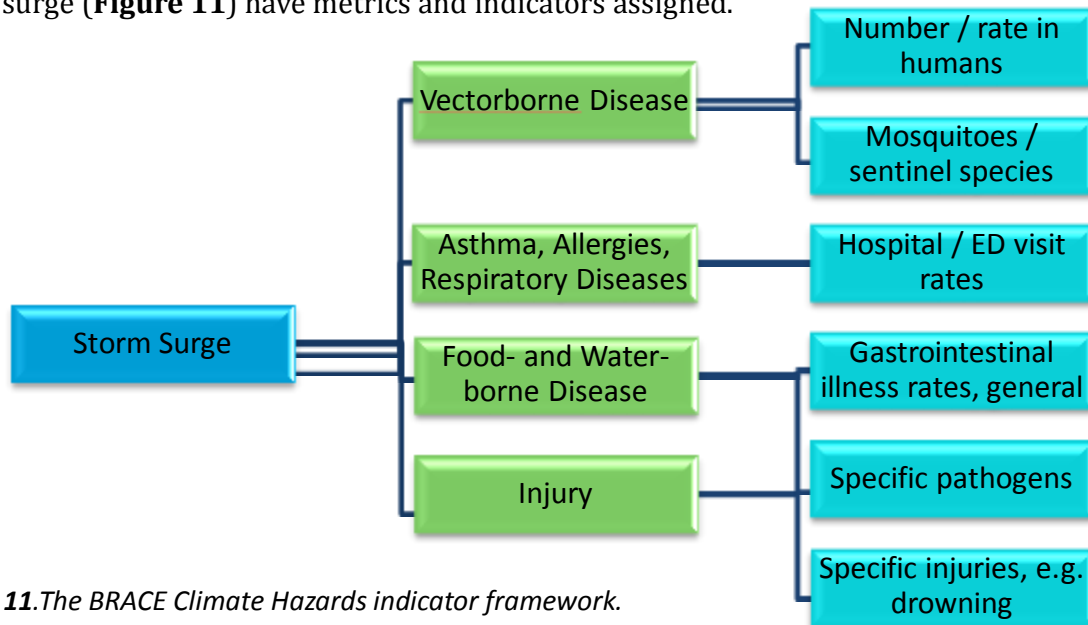
**Figure 10.** Summit Poster for Economic Evaluation of Everglades Ecosystem services - Valuing Ecosystem Services of a Restored "River of Grass" by Arthur R. Marshall Foundation.

### SESSION THREE: INTEGRATING THE HEALTH IMPACTS OF SEA LEVEL RISE INTO RESILIENCY & ADAPTATION PLANNING

Moderators **Debora Kerr**, formerly Chief Operating Officer, Florida Public Health Institute & **Isabel Cosio Carballo**, Southeast Florida Regional Partnership Coordinator, South Florida Regional Planning Council opened the session to identify on-going efforts and gaps in understanding the health impacts of sea level rise into resiliency and adaptation planning.

Panelist **Maribeth Gidley** discussed her work with the National Oceanic and Atmospheric Administration (NOAA) and presented a national viewpoint of the health implications of sea level rise. A recent NOAA project was initiated to explore how changes in our ocean will impact human health and Gidley described how an average family in the future could possibly be impacted. Families may have limited and costly potable water resources due to environmental contamination to the water supply. Many families will become climate refugees, having to move inland from the coast. Gidley discussed other health impacts, including food production and security, inundation, and property destruction. A social justice issue arises as many vulnerable neighborhoods lack the resources needed to respond to these impacts. Storm surge will bring contaminants from the shorelines, while inland flooding from broken sewage lines and other sources will release various contaminants. South Florida is already dealing with algal blooms offshore and may have more fertilizer contamination due to flooding, which could further degrade water quality. All these impacts can affect a region's ability to produce food. South Florida is a major producer of winter vegetables, and changes in climate will ultimately impact food availability.

Panelist **Kristina Kintziger** described the *Building Resilience Against Climate Effects* (BRACE) program of Florida Department of Health which models a wide range of environmental effects that occur with climate variability. Changes to ecosystems and storm effects on coastal environments can lead to negative health impacts for individuals. BRACE's overarching goals are to provide guidance to localities to develop strategies and focus on stakeholder engagement. BRACE recognizes that climate can have profound impacts on human health. Florida is known for its unique climatic events. Addressing the possible effects on human health in the public health sector will enable Florida to become more resilient to climate variability as well as increasing public awareness and responsiveness. For example, the health effects of storm surge (**Figure 11**) have metrics and indicators assigned.

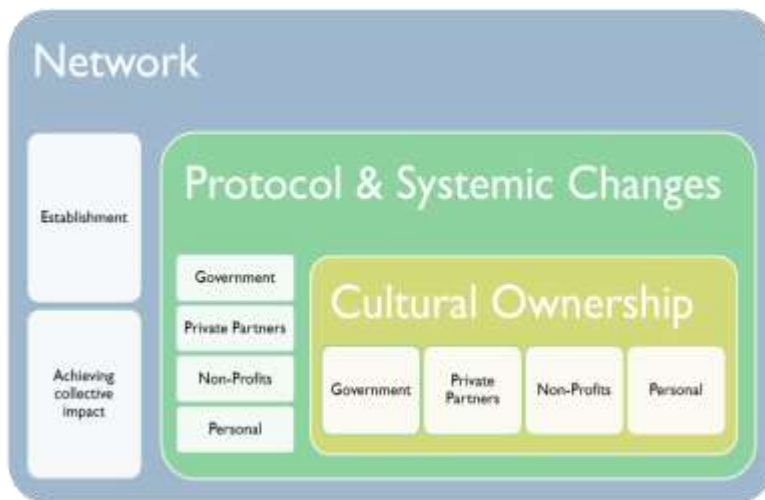


**Figure 11.** The BRACE Climate Hazards indicator framework.

Panelist **Nancy Gassman** discussed the infrastructure challenges that will be exacerbated in the future by sea level rise. Drainage systems are designed to drain from a property to a surface waterway. However, in a canal system, water will back up into the drainage system as tides push it inland. Whether you live inland or on the coast, someone will have to pay to drain the water. Adaptation options already being implemented include the use of backflow preventers that stop water from flooding the system. Pump systems can overcome elevation issues that prevent water from flowing in certain directions naturally. The goal is to prevent flooding that leads to health issues. The water supply for a majority of Miami comes from the Biscayne Aquifer, which is threatened by saltwater intrusion. Over 3 million people have a water source that is vulnerable to salt water contamination. In some cases well fields have been moved inland; this water is subsequently piped back to coastal communities. New treatment options can remove salt, but these technologies are expensive and use a lot of energy.

Panelist **Anamarie Garces** considered a grassroots approach to creating a climate change network for decision makers. How do we establish networks for decision makers? How do we determine our actions and roles? Will this be a shifting cultural norm? A successful climate change network should be cross-sector (environmental, health, transportation, agriculture, water/drainage, etc.), consider economic welfare and policy, and extend from grassroots to executive levels. Five conditions for collective success are: a common agenda, shared measurement systems, mutually reinforcing activities, continuous communication, and support from essential organizations. Government support could come in the form of an economic component, inclusion of network reps on county and city boards, support of research and vulnerability mapping and the development of emergency preparedness and advisory warnings

for all scenarios. Personal actions include emergency preparedness; individual choices/responsibility; and awareness of local emergency relief, education, and civic participation. We need to establish a structured process that leads to a shared mission to help inform South Floridians of their choices regarding mitigation and adaptation (**Figure 12**).



**Figure 12:** Applied Action Framework example

Panelist **Keren Bolter** asserted that health impacts are a major consideration of climate change that is often overlooked. Her research includes conducting sea level rise vulnerability assessments for Southeast Florida. To determine who we should be most concerned about, she looks at data to find the areas most vulnerable both physically and socioeconomically.

Physical vulnerability is determined based on elevation, storm surge zone and flood risk. People living in these areas are then assessed to find which communities lack the funds and the mobility to respond to the effects of sea level rise. Considering these two dimensions, some hotspots with low socio-economic incomes at low elevation are the Sistrunk area in Fort Lauderdale and the area around the Golden Glades interchange in North Miami. We need to be concerned about these communities as their lack of opportunities will be exacerbated by sea level rise. Health impacts should be added to this equation via a third dimension. Climate health effects are related to increased temperatures and extreme weather. Impacts specific to sea level rise have critical health implications and will affect different populations in varying degrees (**Table 4**). When doing a cost-benefit analysis for sea level rise planning, it is recommended that we consider the health implications of each adaptation option. We can integrate health into existing adaptation efforts and policy.

**Table 4: Sea level rise Health Risks, an initial selection of corresponding health exposures, and populations that are particularly vulnerable to these exposures**

Physical Risk	Health Exposure	Vulnerable Populations
<b>Higher Storm Surge</b>	<ul style="list-style-type: none"> <li>• Mental health issues from               <ul style="list-style-type: none"> <li>○ property damage</li> <li>○ displacement</li> </ul> </li> <li>• Injury and accidents</li> </ul>	<ul style="list-style-type: none"> <li>• Coastal populations               <ul style="list-style-type: none"> <li>○ Elderly, handicapped, of children living in high rises</li> <li>○ Remote from emergency services</li> <li>○ mobile home residents</li> </ul> </li> </ul>
<b>Increased Flooding</b>	<ul style="list-style-type: none"> <li>• Waterborne disease vectors</li> <li>• housing dislocation</li> <li>• limited health care access</li> <li>• Nutrition/ food supply</li> <li>• Exposure to mold</li> <li>• Drowning</li> </ul>	<ul style="list-style-type: none"> <li>• Low socioeconomic status</li> <li>• Handicapped, elderly, children</li> <li>• Residents of mobile homes</li> <li>• People living in areas with outdated drainage</li> <li>• People with respiratory illness</li> </ul>

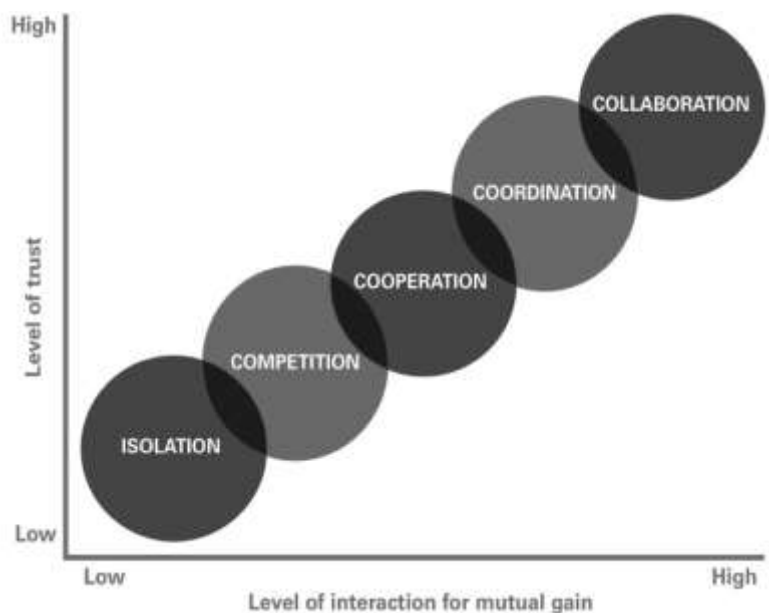
<p><b>Raised Water Table</b></p>	<ul style="list-style-type: none"> <li>• Contaminated water supply <ul style="list-style-type: none"> <li>○ Landfill/Brownfield seepage</li> <li>○ Sewage and toxic pollutants release</li> <li>○ Saltwater Intrusion</li> </ul> </li> <li>• Unstable foundation from saturated soil</li> </ul>	<ul style="list-style-type: none"> <li>• Low socioeconomic status</li> <li>• Handicapped, elderly, children</li> <li>• People living near impaired waters, septic tanks,</li> <li>• People who get water from wells near contaminated areas</li> </ul>
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**Day Two: WELCOMING SPEAKER: FILMMAKER BEN KALINA**

**Ben Kalina**, director of the sea level rise documentary, *Shored Up*, explained why he made the film. For many people global warming and sea level rise are terrifying concepts too large to comprehend or address. His film follows characters people can identify with, including residents of barrier islands and surfers, many who are layman experts on waves and weather. He explored the personal stakes and political conflicts in the communities of Long Beach Island, NJ and the Outer Banks of NC, both extremely vulnerable to the effects of sea level rise. In the larger picture Kalina asks: how are coastal communities coping with sea level rise? Hurricane Sandy showed that if the perceived threat is low, no significant action occurs. Kalina documented emotional responses like the post-Sandy campaign “Stronger than the Storm,” and suggested that the next slogan should be “Smarter than the Storm.” In Florida sea level rise has become a catalyst across political parties, but long term planning is critical as municipalities may be on their own.

**SESSION FOUR: IMPACTS ON BUILT ENVIRONMENTS - ENVISIONING A NEW PARADIGM**

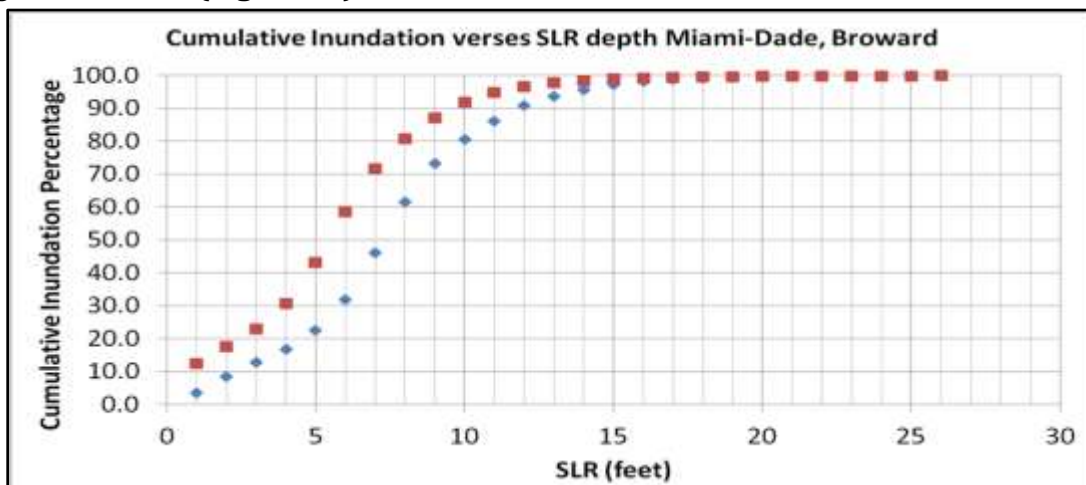
Moderator **Anthony Abbate**, of Florida Atlantic University, discussed the current tipping points regarding sea level rise and the built environment. Such tipping points indicate the need for us to change the way we think through these challenges - and further indicate the need for designers to engage in a collaborative effort to understand and act on these challenges. He pointed out that many fields and disciplines work in isolation and at the other end of the scale, collaboration is heavily dependent on trust among the participants, a focus on joint problem solving, and partnership on many issues based on concern for mutual gain or benefit. He asked the audience to think about where they and their colleagues currently lie on the scale shown in **Figure 13** and how we all might effectively engage in a common strategy moving forward.



**Figure 13.** Source: *The Transportation Research Board*

Panelist **Paul Zwick** discussed the challenges of modeling storm surge and sea level rise. His example for Bay County, Florida considers the still water height, the wave setup and wave crest in relation to the digital elevation model (DEM). The bathtub model does not account for dynamic variations, but wave effects are considered in the FEMA V-zone (coastal areas subject to inundation by the 1-percent-annual-chance flood event with additional hazards associated with storm-induced waves). Zwick aggregates the parcel data to identify vulnerable urban and agricultural properties. A problem often encountered is in effectively communicating uncertainties in source data to the public. Digital Elevation Models and GIS data are used to effectively model increased storm surge impacts due to sea level rise. Planners need high resolution, high accuracy DEMs & quality GIS data (e.g. land parcels) for modeling storm surge.

Panelist **Fred Bloetscher** introduced some innovative ideas to address the engineering challenges that sea level rise presents, particularly when changes in rainfall and groundwater storage are considered. Bloetscher suggested that our greatest problem in the future will be an excess of water. He showed the drastic increase in inundation when inland groundwater pooling is considered (**Figure 14**).



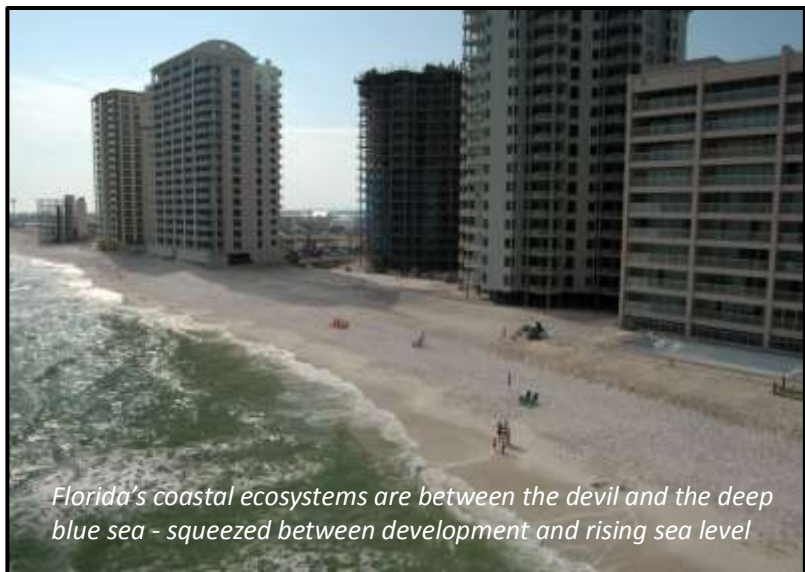
**Figure 14.** RED points indicate land area inundated when groundwater lifting is applied to the bathtub model versus BLUE points, which indicate land area inundated based solely on bathtub model. ([www.ces.fau.edu/climate\\_change/fdot.php](http://www.ces.fau.edu/climate_change/fdot.php)) Bloetscher, 2012

Another challenge will be the progression from seasonal to monthly, daily, and finally, permanent inundation of the roads in the region which are at lower elevations than the buildings. Adaptation options for these issues include installing additional coastal salinity structures, raising road beds, abandoning less critical roads, increasing stormwater pumping and adding stormwater retention and wellpoints (permanent pumping systems). Having a no-regrets strategy will be key when considering these options.

Panelist **William Tilson** introduced the idea of megaregions: chains of once separate metropolitan areas that have grown together to form geographically extensive and continuously populated regions. Through his research he has developed a megaregion evacuation model that incorporates the transportation options of the Gulf Coast region from New Orleans to Houston. He estimates time, speed and management for optimizing evacuation procedures using a TRANSIMS traffic simulation system. Results describe six scenarios through which practical effects of capacity and demand management techniques, such as contraflow and phased evacuation orders, can be assessed. Highway design, traffic operations and evacuation routes need to be examined. Considering traffic movement and human behavior allows them to forecast conditions for clearance times and find the breaking point for these systems under sea level rise scenarios.



Panelist **Reed Noss** considered the natural environment's adaptation response to sea level rise in Florida and explained that our coastal ecosystems are squeezed between development and rising sea levels. It is important to consider coastal natural ecosystems, such as mangroves and grasslands, for sea level rise protection in Florida. The only long-term management response is retreat, where we relocate inland and allow the natural ecosystems to migrate inland as they did in the past.



Large scale coastal hardening (such as seawalls) floods out our natural ecosystems and disturbs migration. Protecting natural coastal ecosystems and allowing them to migrate inland will protect land from rising seas. An exclusive focus on protecting people and the built environment is counter-productive and self-defeating. Natural ecosystems can provide valuable protection from sea level rise impacts. Adaptation options that are sensitive to coastal natural systems include ecosystem engineering, managed retreat, living shorelines, and the facilitation of habitat migration.

Panelist **Michael Lingerfelt** described an architect's role in building resilience and post-disaster response. His program trains architects to serve as second responders through the Safety Assessment Program. They can inspect elements of the built environment for habitability. To enhance community resilience, they aim to utilize assessment experience to improve land use and building design in response to increasing risks. A main challenge is developing better building codes and reducing liability via availability of insurance related to these procedures.

Panelist **Jim Gall** stressed the importance of learning through experience. Rather than responding to catastrophes, we should be thinking about what catastrophes are going to happen, and prepare ourselves in advance. Design is a social process; it involves people and, therefore, is complicated, non-linear and not individual. It operates at a cultural level and can bring about cultural change. We should use design as a social and cultural process to deal with sea level rise.

Panelist **David Waggoner** contrasted New Orleans with Dutch water adaptations. After 800 years of water management experience, the Dutch use advanced technology and a layered approach to store water, considering all possible sources and storage opportunities. In a delta area like New Orleans, rivers and storm surge are sources, in addition to rainfall. Pumping solutions must take into account the kind of soil, the possible induction of subsidence, and the fact that urban water runoff has a radical effect on climate change. We should think at different scales: from house to block to neighborhood and up to the watershed. Systems can be set up to be monitored and adapted, so that we can find sustainable solutions.

Panelist **Brian Wolshon** explained how transportation infrastructure determines evacuation strategy: where people can go, what routes are available and when they might wash out. The models use megaregions which describe chains of once separate metropolitan areas that have grown together. Using actual hurricane events which could have resulted in widespread evacuations, scenario modeling demonstrates traffic patterns on a microscopic level, reflects simultaneous multi-city travel activities, forecasts maximum route capacities and how we can respond with demand management techniques.

## **SESSION FIVE: LOCAL, NATIONAL & INTERNATIONAL ADAPTATION, INNOVATION & RESILIENCE**

### **Part 1: Reports from the Field**

Moderator **Dr. Leonard Berry** suggested the ultimate goal of this session would be to develop a toolkit, a set of procedures or issues that would allow counties, municipalities, and other entities to address their own climate change issues. He asked the panelists if they felt that there is a need for an ongoing network to address adaptation. Should we develop an adaptation information exchange between the Gulf Coast of Florida and the Eastern Seaboard? If so, do we currently have enough data to develop an adaptation toolkit for our region? If we don't have the data, what is missing? How do we create a toolkit of procedures that allow counties, municipalities and organizations to begin to address local adaptation problems? The panelists responded to these questions in their presentations.

### **Local Reports from the Field**

Panelist **Kristen Jacobs** described how South Florida has been experiencing the impacts of climate change for years. She discussed the strides that the Southeast Florida Regional Climate Change Compact has made in the past several years, working together to create a 110-item Regional Climate Action Plan. A unified sea level rise projection gives planning horizons, and mapping projects integrate adaptation action areas, which identify vulnerabilities. For Broward County, it has been important to take assessments to the city level for implementation of adaptation policy and climate resilience to be successful. Broward has amended land use plans to integrate sea level rise. Miami addressed its storm water “nuisance” flooding early on, paving the way for funding and a creating sea level rise adaptation as it took on greater implications. Addressing risk over the long-term and reevaluating how we respond to disasters is the best strategy for this success.

Panelist **Jim Murley** discussed three key strides in adaptation for our region. The first was the Adaptation Action Area Pilot Project in Fort Lauderdale, which is kicking off with an adaptation policy options report and guidebook for local governments. The second was the federally funded Seven50 SE Florida Prosperity Plan, a resiliency plan for 7 counties for the next 50 years ([www.750.org](http://www.750.org)). The third was the recently released Urban Land Institute report, which outlined climate change risk and resilience in coastal regions ([www.uli.org/wp-content/uploads/ULI-Documents/CoastalRegions.pdf](http://www.uli.org/wp-content/uploads/ULI-Documents/CoastalRegions.pdf)). This study has a section on the key role of insurance, as well as the market price risks in these areas. In Miami, the property market has been booming, but they are pricing for profit, and not for long-term risk. There is a vulnerability price to pay to live near the coast, and this is not yet reflected in insurance rates or property value.

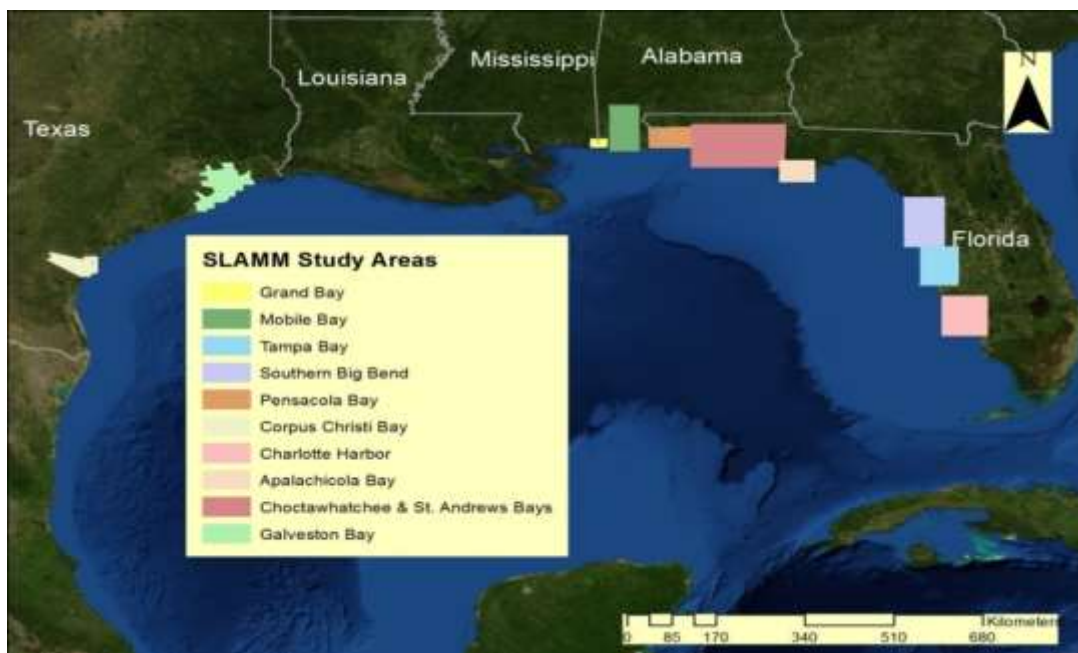
Panelist **James Beaver** described “Climate Readiness Planning” at the Southwest Florida Regional Planning Council and the Charlotte Harbor National Estuary Program. These groups have been involved in multiple projects related to climate change, including the first *Florida*

*Climate Ready Estuaries Program*, the creation of a Comprehensive Southwest Florida/Charlotte Harbor Climate Change Vulnerability Assessment and Technical Report, and the Adaptation Plan for the City of Punta Gorda Technical Report. Beever gave two key tips for how to facilitate planning for climate change: engaging the public and using new language (**Table 5**). Several of the region’s key strategies include maintenance and prioritization of existing marsh migration corridors, acquisition of inland buffer zones to facilitate migration, restoration support, the addition of sediment-slurry to assist in the marsh building processes, and elevation of roadway berms.

**Table 5: Social Engagement Strategies for Climate Change Outreach**

A Public Process Driven by Public Input	Using New Language: (Call It What It Is)
<ul style="list-style-type: none"> <li>• Using Public Participation Games, Interviews, Pre and Post Surveys, and Other Tools</li> <li>• Implementable &amp; Currently Implemented Cost Conscious (Cost/Benefit) and Favoring No Regrets Actions</li> <li>• Incorporated, not Separated, from Comprehensive and Transportation Plans</li> </ul>	<ul style="list-style-type: none"> <li>• Redesign (not Accommodation)</li> <li>• Managed Relocation (not Retreat)</li> <li>• Armoring/Diking/Filling (not Protection)</li> </ul>

Panelist **Laura Geselbracht** described how The Nature Conservancy recently modeled the impacts of sea level rise on coastal wetlands and adjacent uplands at ten major estuarine systems across the U.S. Gulf of Mexico region (**Figure 15**). These new studies provide detailed information on likely changes to specific wetland systems and adjacent dry land areas (both developed and undeveloped) through the year 2100. This information, in turn, identifies potential impacts on vulnerable species and human infrastructure and enabled local stakeholders to develop locally relevant adaptation strategies. In addition, the modeling results have been incorporated into the Conservancy’s web-based Gulf Restoration Decision Support Tool along with socio-economic information and special applications that can help users identify communities at risk and the effects that various management actions will have.



**Figure 15.** Modeled Effects of Sea Level Rise on Coastal Habitats for 3 sea level rise scenarios: 0.7m, 1m, & 2 m.

Panelist **Curtis Sommerhoff** stated that sea level rise hasn't routinely been in the vocabulary of emergency agencies, and often isn't identified as a hazard. Fortunately, it is now included in the Miami-Dade's Comprehensive Emergency Management Plan and modification of several water management structures are increasing our resilience. The Tamiami Canal (C-4) forward pump is designed to push water against the tide, and the Miami River (C-6) forward pump is designed to counter the effects of the C-4 Pump. These large pumps move outflow or flooding waters regardless of the incoming or outgoing tide. A recent Regional Evacuation Study modeled storm surge using the SLOSH method to redesign evacuation zones, optimize evacuation routes and times, and prevent recurrence of displaced populations after incidents, damage to small business, limited access and repetitive claims of insurance. Communities up to 10 miles inland are affected by the storms modeled and residents need to understand how they are at risk to impacts like inland inundation from storm surges.

Panelist **Fernando Vazquez** described various engineering projects in Miami-Dade County, Dania Beach and Fort Lauderdale's coastal communities and provided a perspective for addressing sea level rise and resilience in real time. He described the flooding from high tides on Alton Road that has been occurring for several decades as a result of outdated rules and regulations from Miami Beach's 1997 Stormwater Master Plan. This plan was no longer meeting the community's needs to renew infrastructure, address flooding and modify roads; a plan that integrated adaptation measures was needed. Analyzing flooding in areas such as the art deco district and West Avenue areas was quite challenging; as was acquiring funding and speaking with elected officials to finance the plans. The Stormwater Plan helped to shift the paradigm in Miami and allowed people to understand that flooding wasn't just a nuisance but a serious problem. Fort Lauderdale also recognizes that the funding should be allocated to prepare a diligent sea level rise plan for the city's future.

### **National Reports from the Field**

Sea level rise is not only affecting Florida but other parts of the nation in unique ways. Addressing infrastructure risks in the face of sea level rise has greatly altered the approach of many organizations. Florida's economic activity and future development takes place on our coastlines and not addressing the implications of climate change would be a costly mistake. Simple alterations to infrastructure design can make all the difference in planning for a sustainable future and may often be the most cost effective option in long-term planning. Another important consideration is how natural areas provide coastal resilience. Modeling of coastal resources such as marshes, mangroves, and oyster reefs and their buffering of sea level rise, may help us better understand where to focus mitigation and restoration efforts.

Panelist **Henri Boulet** discussed Louisiana Highway One (LA 1), which is the main artery for the nation's busiest intermodal energy port, Port Fourchon, and the only way to get to Louisiana's inhabited barrier island, Grand Isle. Port Fourchon relies on LA 1 as its sole highway access for supplies. **Figure 16** shows the unprecedented damage done to sections of this road during Hurricane Isaac. Reopening the road to Fourchon immediately after storms is essential as it calms national energy markets. A NOAA study found that by 2030 the road will be closed 6% of the year, and by 2050, it will be closed 55% of the year. A 2011 US Dept. of Homeland Security performed an Assessment of Consequences of Disruptions to LA 1 and determined a risk of \$7.8 billion of loss to the gross domestic product. Stakeholders of this vulnerable sole-access coastal highway have leveraged a federally authored campaign to increase awareness and generate funding for a much needed infrastructure adaptation project. Boulet discussed the various funding mechanisms employed for the \$370 million LA 1 Improvement Project to date and additional funding mechanisms that support the nonprofit LA 1 Coalition in obtaining another \$320 million to complete a storm-resilient 19-mile elevated highway.



**Figure 16.** Category 1 Hurricane Isaac brought unprecedented damage to LA 1

Panelist **Joe Bouchard** stressed that sea level rise is creating challenges for US national security, both internationally and within the United States. The Department of Defense (DOD), Armed Services and the intelligence community have been studying the security implications of sea level rise for the last decade. In the DOD, the Strategic Environmental Research and Development Program (SERDP) is conducting assessments of the vulnerability of US coastal and island military bases to sea level rise. His key recommendations were to start investing in adaptation now and include projected sea level rise in the design of new or replacement infrastructure. He advised not waiting until it becomes a crisis and that acting now is the best way to ensure a robust economic future. Bouchard recommended giving priority to critical infrastructures including the electrical grid, transportation systems, water, sanitation, telecommunications, etc. (the challenge is that some of these are privately owned.) He concluded by describing the adaptation-mitigation tradeoff: mitigation fosters new industries, grows the economy and creates new jobs while adaptation only reduces economic loss.

Panelist **Tim Osborn** was unable to attend the Summit and his presentation was provided by Henri Boulet. He discussed cumulative sea level rise and subsidence impacts on coastal Louisiana and the Northern Gulf. The coastal landscape in Louisiana is experiencing rising sea levels impacting coastal populations, flood protection structures, infrastructure and the majority of the economic base of the state. Sea level rise, amplified greatly by high rates of subsidence, is converting coastal areas at a rate that is among the highest in the world. Projections of this cumulative rate will see an overall impact to approximately 12,000 square miles of the coastal zone in the next several decades. Osborn presented a review of the techniques measuring these large rates of sea level rise and subsidence, how they are verified along the coast with field observations and studies, and a representation of the various types of impacts. Osborn described several plans including building up wetlands, creating large diversions to push sediment out of the rivers, and moving oyster beds up into the basin as saltwater intrudes and sea level rises.

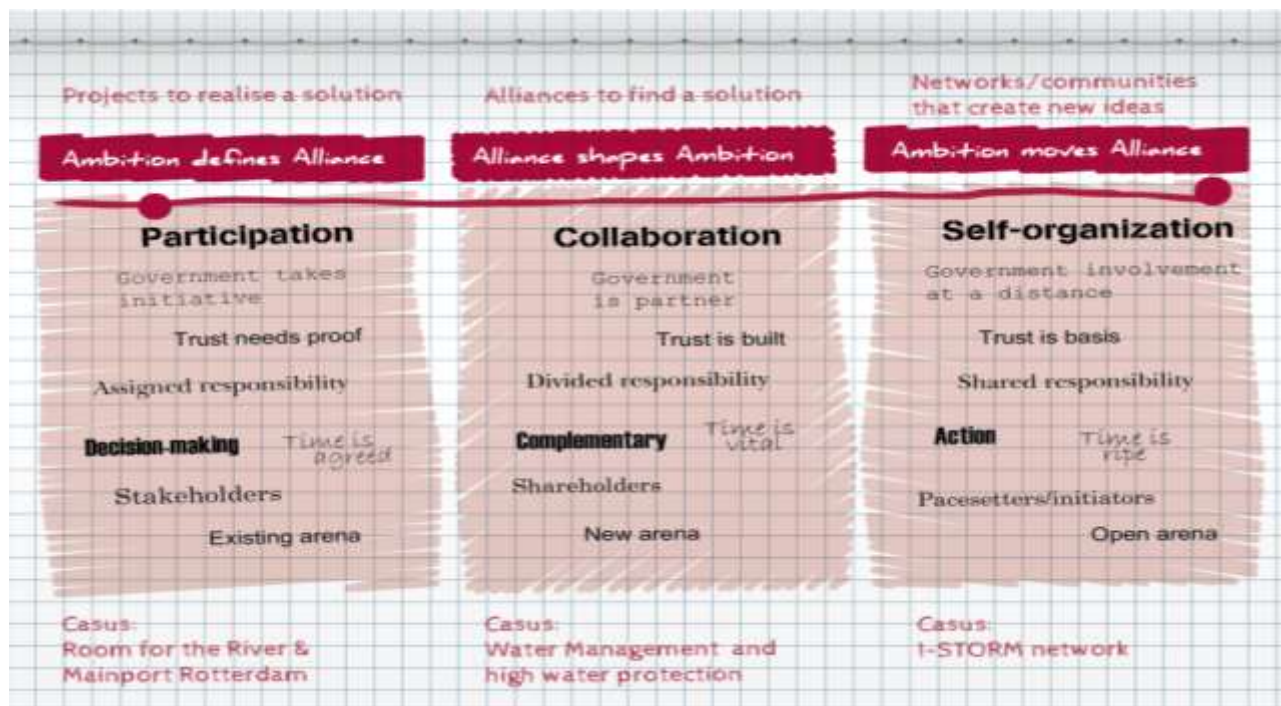
## Part 2: Global Adaptation Perspectives

International panelists from Mexico, the Netherlands, England and Australia shared their perspectives as low-lying countries surrounded by water. These countries have a long history of using engineering strategies, such as hardening structures, to provide protection for their social and economic structures. However, over time, valuable lessons were learned that are now helping to address adaptation in a future facing climate change and sea level rise issues.

**Carlos Constandse** was unable to participate on the panel and his presentation was given by Ricardo Alvarez. He explained that in Cancun, Mexico, the majority of tourism development is based on hardening their shorelines. International tourism has flourished on this migrating dune island, but major storms have negatively impacted tourism. Due to numerous hurricanes and natural wave impacts, these hardened beaches are not providing the best solution. He described how in 1988 Hurricane Gilbert heavily eroded the beaches. A Belgian company restored them through a renourishment project but the sand was lost again in 2005 during Hurricane Wilma. Instead of continuing to harden their beaches, Constandse recommended that new approaches include “interacting with nature” to integrate the natural protection provided by wetlands into communities coastal resilience plans.

Panelist **Pim Nijssen** described how the Dutch have refined the water governance approach – an integrative approach of water techniques and environmental planning that implements adaptation strategies over time (**Figure 17**). Water governance means multiple parties (including government) interact in decision making and implementation (versus solely government). This concept makes room for adaptations to be incorporated in the built environments and permits creative solutions.

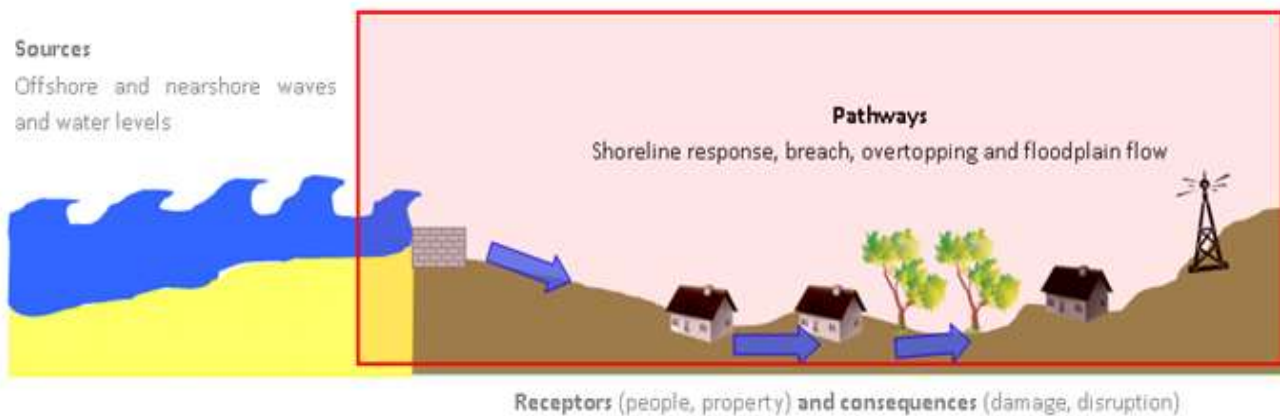
Nijssen gave two examples of thinking outside the box: the National Delta Program and Room for the River Program. Both of these projects required collaboration at multiple levels of the public and private sector. They stem from the motto “fight back the water, but fight together!”



**Figure 17:** Three tiers that underlie the foundation of water governance

Panelist **Rosemary Kennedy** said that Australia, like many other countries, finds the majority of its population situated along its coasts and severely threatened by the implications of climate change. Yet, the country does not fully embrace this issue as a national agenda. The policy departments in charge of climate change have been reduced or eliminated. Coastlines are increasing in some places because the sediment supply is sufficient, creating a false sense of security. However, Kennedy described a history of storms that have caused severe flooding and damage. A major issue is that areas prone to storm surge share South Florida's problems of a high water table in their coastal aquifer and yet there are no backflow options. With hesitance from the government to participate, they are focusing on the private sector to address how they can improve on existing systems to address their sea level rise issues.

Panelist **Matthew Wadey** described how England faces threats from encroaching storm surges on their built environment and the role of academic research in addressing sea level rise impacts. This research includes assessing flood characteristics through modeling on a fine scale that allows adaptations to be implemented to address the changes and damages that sea level rise could impose locally (**Figure 18**). Research examples of coastal flooding included his own flood simulation method with a case study in the Solent, a strait separating the Isle of Wight from the mainland of England. The regional-scale coastal flood modeling methods used simulations to focus on smaller areas such as the City of Portsmouth. Increased understanding of coastal flooding mechanisms has allowed for robust adaptation strategies to be considered.



**Figure 18.** Flood simulation methods must consider defense failures as well as flood dynamics.

## SUMMARIES, CONCLUSIONS AND RECOMMENDATIONS

**Session One** panelists discussed the combination of sea level rise and storm surge, particularly in South Florida. The South Florida Water Management District is faced with the challenge of aging flood control structures that must be adapted with pump stations in order to drain inland floodwater. Miami-Dade County is preparing for storm surge in the face of sea level rise by creating new evacuation zones that extend to the western edge of the county. Translating the risk of storm surge to the public so that they can prepare for storm related emergencies is imperative and, in order to reach large audiences, we must consider multiple access points into the community. Remembering that this is not just a technical issue but also a 'people problem' is important. Effectively informing and engaging the public, property owners, the business community, voters and taxpayers is a key challenge but a critical one to overcome.

**Session Two** examined the economic implications of sea level rise. The panelists emphasized the necessity of identifying and disclosing assets at risk and discussed the need to incorporate sea level rise into business and development plans for coastal communities. Joint solutions from government, business and communities are required so that businesses are more able to

incorporate sea level rise into their long-term plans, thereby providing uninterrupted services in the wake of hurricanes and other catastrophic events. A five-year plan is underway to incorporate sea level rise into the development plans for Florida's coastal communities. The effectiveness of the plan's outcomes will be evaluated in the last two years to ensure that any problems encountered are addressed. Disaster recovery policies must be redesigned to prevent development in high sea level rise risk areas. Presently, subsidies prevent the average coastal resident from paying the true insurance cost and approximately one quarter of these subsidies are for coastal vacation homes. If insurance is incorrectly priced, both insurance companies and the environment face additional risk. Subsidies delay investment in mitigation. Investment in wetlands can actually reduce insurance rates. Redevelopment in these coastal areas only increases environmental degradation to those ecosystems. Laws need to be examined to reduce vagueness in current policies and sea level rise should be incorporated into law school curriculum.

The importance of integrating the health impacts of sea level rise into resiliency and adaptation planning was discussed in **Session Three**. The health impacts of climate change are often overlooked. One program in Florida is modeling the effects of climate change that can negatively impact residents. An example of a local climate change impact is our region's ability to produce food; a changing climate could dramatically decrease Florida's winter vegetable production. Those most vulnerable to health impacts may be residents with low socio-economic incomes living at low elevations as they will be the least able to respond. It is necessary to improve drainage system infrastructure, preventing flooding in coastal communities which lead to health issues. Establishing a structured process, such as a climate change network for decision makers, may help inform South Floridians of their choices regarding mitigation and adaptation.

**Session Four** highlighted the need for community designers to engage in a collaborative effort to understand and act on the challenges of sea level rise impacts on the built environment. Current bathtub models don't account for dynamic variation, and therefore, modeling storm surge and sea level rise impacts is challenging. High resolution, high accuracy DEMs and quality GIS data modeling storm surge are needed. One potential impact as sea levels rise is increased inundation from inland groundwater pooling. Architects should consider resilience and post-disaster response in their designs. Developing better building codes and reducing liability related to these procedures will be a challenge. A layered approach may be necessary to reach these goals. To facilitate rapid evacuation, in response to a hurricane for example, a megaregion evacuation model has been developed that incorporates transportation options and estimates time, speed, and management for optimizing evacuation procedure. To protect Florida against the impacts of sea level rise, our natural coastal environments are an important consideration. Ecosystem engineering, managed retreat, living shorelines, and the facilitation of habitat migration are adaptation options that are sensitive to coastal natural systems.

**Session Five** began with highlights of projects and programs underway in the region. A driving force for South Florida has been the Southeast Florida Regional Climate Change Compact and the development of a Regional Climate Action Plan. Key strides in adaptation measures are being made through multiple local and regional projects being funded by state and federal agencies. Southwest Florida has been implementing 'Climate Readiness Planning' through multiple projects and provided two key social engagement tips to aid in planning for climate change – develop a new way of communicating the issues and engage in a public process that is driven by public input. In addition, studies in the Gulf Region have identified potential impacts on vulnerable species and human infrastructure and include web based tools that can be



utilized to identify communities at risk and to see the effects of different management scenarios. Other local projects have shown that communities located up to 10 miles inland will be affected by inundation from storm surge.

**Session Five** also included field reports from Louisiana, the Northern Gulf, and Virginia. A common theme was the fact that substantial economic activity and development takes place on our coastlines and ignoring the implications of climate change will be a costly mistake. It was also noted that addressing risk over the long term and reevaluating how we respond to disasters is the best strategy for success. The session concluded with reports from the Netherlands, England, Mexico, and Australia. These examples were chosen because these countries have had to provide creative, protective measures for their social and economic structures for quite some time. They shared the valuable lessons they've learned that are helping to address adaptation for a future facing climate change and sea level rise issues.

## **CULMINATING DISCUSSION & WRAP UP**

Moderator **Scott Hagen** wrapped up the conference by asking each panelist to summarize a key point of the Summit. Master of Ceremonies Jim Sackett observed that a key issue is how to communicate risk to people who may be impacted. Communication to the general public is going to be huge obstacle. Anthony Abbate agreed, adding that collaboration is essential and that without quality communication throughout communities and the various levels of government, there could be large-scale disruption. Dr. Leonard Berry added that an intense workshop model to formally and informally advise communities should be considered for topics such as health and other issues. Using the best technology and media, we must continue seeking sustainable solutions to address the multitude of sea level rise impacts in Florida.

Julia Higgs commented on how pervasive and interdisciplinary the issues are. Debora Kerr agreed, citing lawyers and other non-traditional partners as a means to spread the message. Ricardo Alvarez identified his key take-away that sea level rise and storm surge could alter our way of life. Translating the science, understanding hazards timelines and possible solutions is the challenge. He would like to present the issue as a current problem needing a solution as opposed to a future risk.

The summit explored and illustrated the wide range of impacts, now and in the future, of sea level rise and the related aspects of climate change. Insurance, policy, planning, design, health care, architecture, finance, legal issues and engineering were all discussed. The need for collaboration and communication was made clear throughout the two days. The science and impacts of sea level rise are often complex and require special skills and expert understanding. Effective translators and dedicated efforts to communicate those findings to appropriate decision makers and stakeholders are needed. Without quality communication, we will have disruption, a lack of understanding, and resulting inaction.

While understanding the updated science was an important introduction to the Summit and understanding the need for mitigation was underscored many times, the core of the discussions were exploring the wide range of impacts of sea level rise on society and the built environment. Looking to the future, we envisage a more detailed exploration of the key issues identified and better translation of ideas into practical actions. The future of life and economy in Florida will depend on our ability to prepare for and deal with the changing environment that awaits us. Much remains to be done.

Speaker presentations are available at the following link: [www.ces.fau.edu/SLR2013/agenda.php](http://www.ces.fau.edu/SLR2013/agenda.php)

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