

Assessing municipal vulnerability to predicted sea-level rise, City of Satellite Beach, Florida

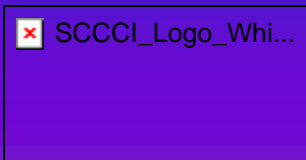
October 26, 2010
Public Library
City of Satellite Beach, Florida

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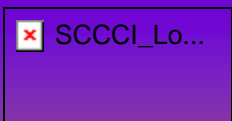
Planning for the future today

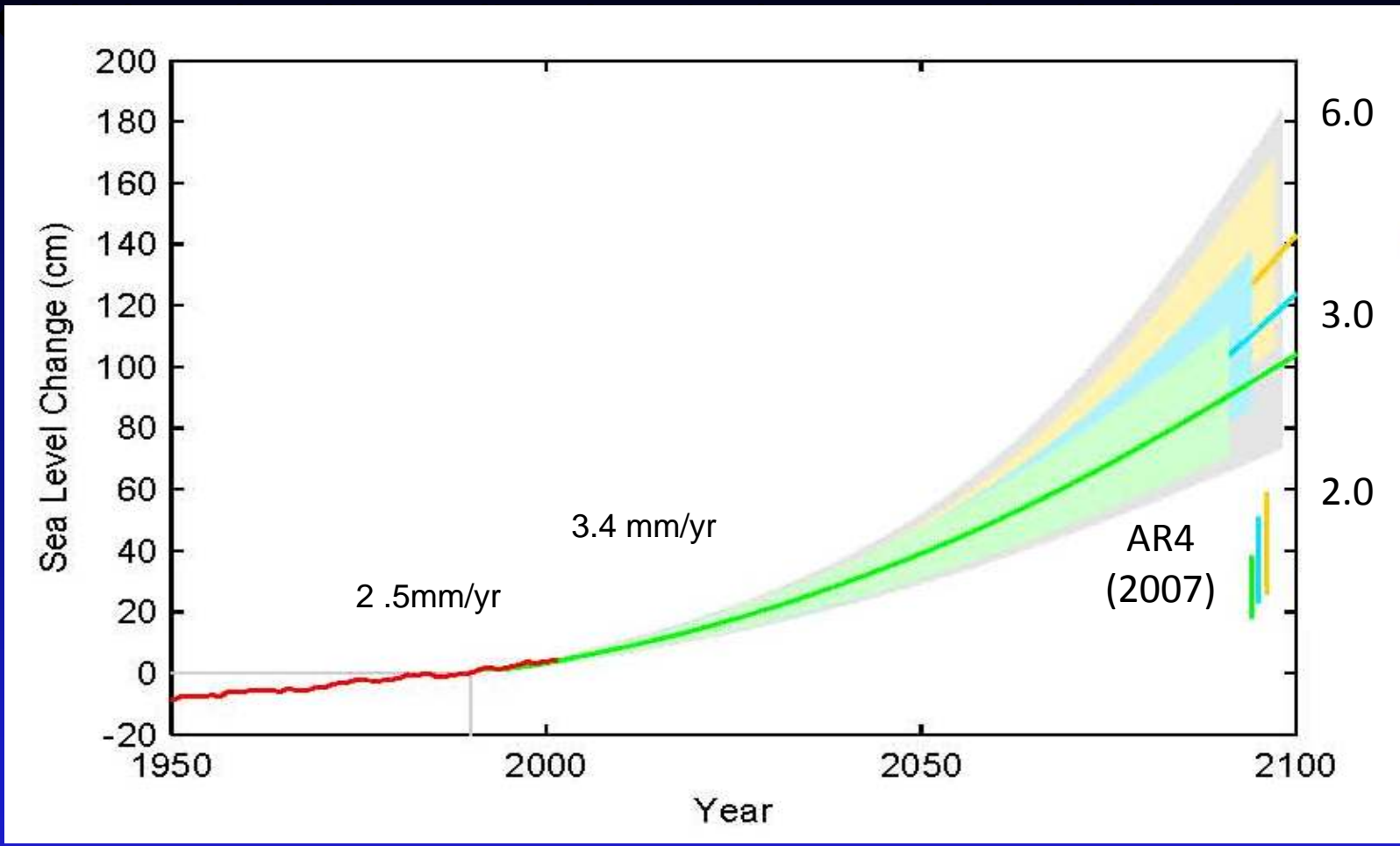
Adapting to Climate Change along the US Atlantic and Gulf Coast

A Florida Perspective

- Coastal areas have historically been managed under the premise that
 - sea-level rise is not significant
 - long-term shoreline change is zero or if erosional can be fixed in place by engineering structures
- Coastal flooding and erosion are predicted to increase concomitant with climate change
- Given the paucity of policies specifically designed to address climate change, protection of Florida's coastal environments (built and natural) from flooding and erosion will require a complete overhaul of planning and management priorities

USCCSP 2009





Sea Level Change (ft)

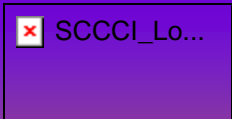
The most recent (2009) sea-level rise projections (above) are considerably higher than previous estimates published by the Intergovernmental Panel on Climate Change (2007; see AR4 in the lower right corner). The higher estimates include the effects of widespread melting of Greenland and Antarctic ice sheets; a process not well understood just a few years ago. Curve modified from Vermeer and Rahmstorf (2009).

In Florida, the recent acceleration in sea-level rise is associated with a 70% increase in coastal erosion

Year	1989	1990	1991	1992	1993	1999	2000	2008
Miles	332	338	350	355	356	429	436	493

“Critical and non-critical” coastal erosion over the past two decades. Data from FDCA 2000 and FDEP 2008

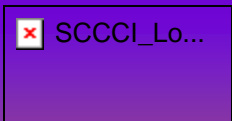
The continued acceleration in the rate of sea-level rise will cause even more erosion.



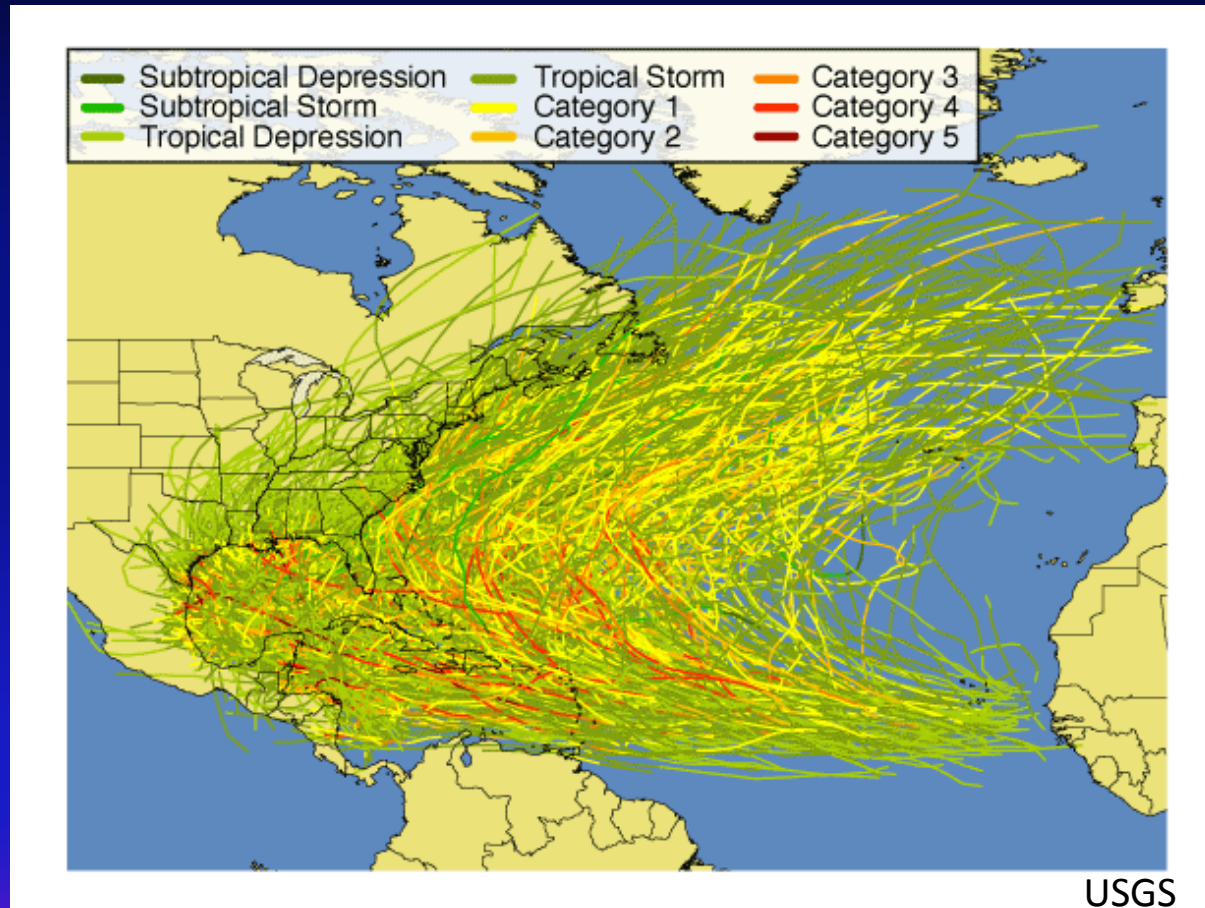
In addition to coastal erosion, rising sea level will increase the frequency and magnitude of coastal flooding



Saltwater flooding of streets in Miami Beach (October, 7, 2010)

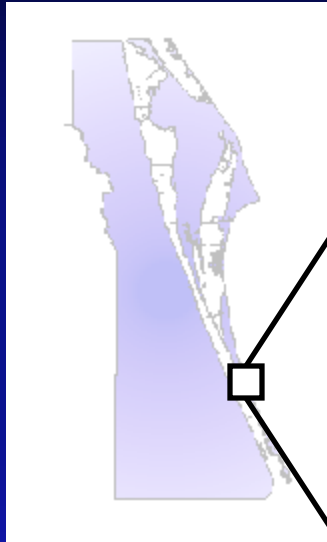


Graphic summary of Western Atlantic storm tracks as recorded during historical time



Climate change is expected to increase the frequency strong (i.e., Category 4 and 5) hurricanes in the western Atlantic (Bender et al. 2010)

Municipal Assessment of Vulnerability to Predicted Sea Level Rise: City of Satellite Beach, Florida



Regional location map
Brevard County, Florida



Land area: 8.8 sq km / 3.4 sq mi
Population (2009): 10,848 or 1,233 per sq km
Land area urbanized: 98%

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Background

Project funded by the US Environmental Protection Agency (EPA)
Climate Ready Estuaries (CRE) Program

The goal of the EPA CRE program is “to enhance local efforts to develop a climate change adaptation plan that may otherwise be limited by inadequate financial resources”

Project team

John Fergus and Laura Canady (CSB)

Bob Day (IRLNEP)

Tara McCue (ECFRPC)

Peter Harlem (FIU)

Space Coast Climate Change Initiative

Randall Parkinson (RWParkinson Consulting, Inc.)

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Project Scope

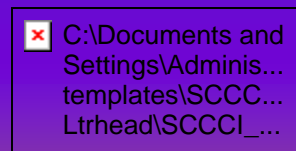
Goal

Provide City officials with the information necessary to

- Fully understand municipal vulnerability to predicted sea-level rise and
- Update municipal planning documents as an initial step towards mitigating deleterious changes to the built and natural environment

Tasks

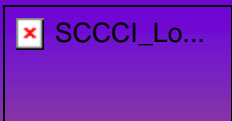
1. Conduct a public education and outreach campaign targeting local stakeholders and decision makers
2. Assess municipal vulnerability to sea-level rise
3. Collaborate with City during review and revision of applicable planning documents



Task 1 – Communicate with stakeholders and decision makers

“Education and Outreach”

- **Public Forums** – utilizing facilities located within and proximal to the City, these events were designed to provide information on climate change and sea level rise with increasing site- and project-specific detail over time
- **“Sea-level rise” Sub-committee** – to ensure effective transfer of technical information to the City’s decision makers, the project team worked directly with a newly formed *Sea-Level Rise Subcommittee* of the City’s Comprehensive Planning Advisory Board (CPAB)
- **FIT Digital Library** – adaptation references at <http://research.fit.edu/sealevelriselibrary>



Task 2 – Assess municipal vulnerability to sea-level rise

Elements

oConstruct base map of City

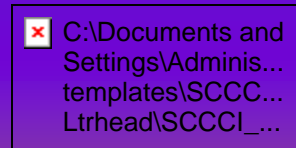
- GIS platform and “existing” files (i.e., roads, boundaries, water bodies)
- Topographic relief (new LIDAR data acquired by FDEM)
- Infrastructure and Critical assets (i.e., electrical sub-stations)

oModel submergence

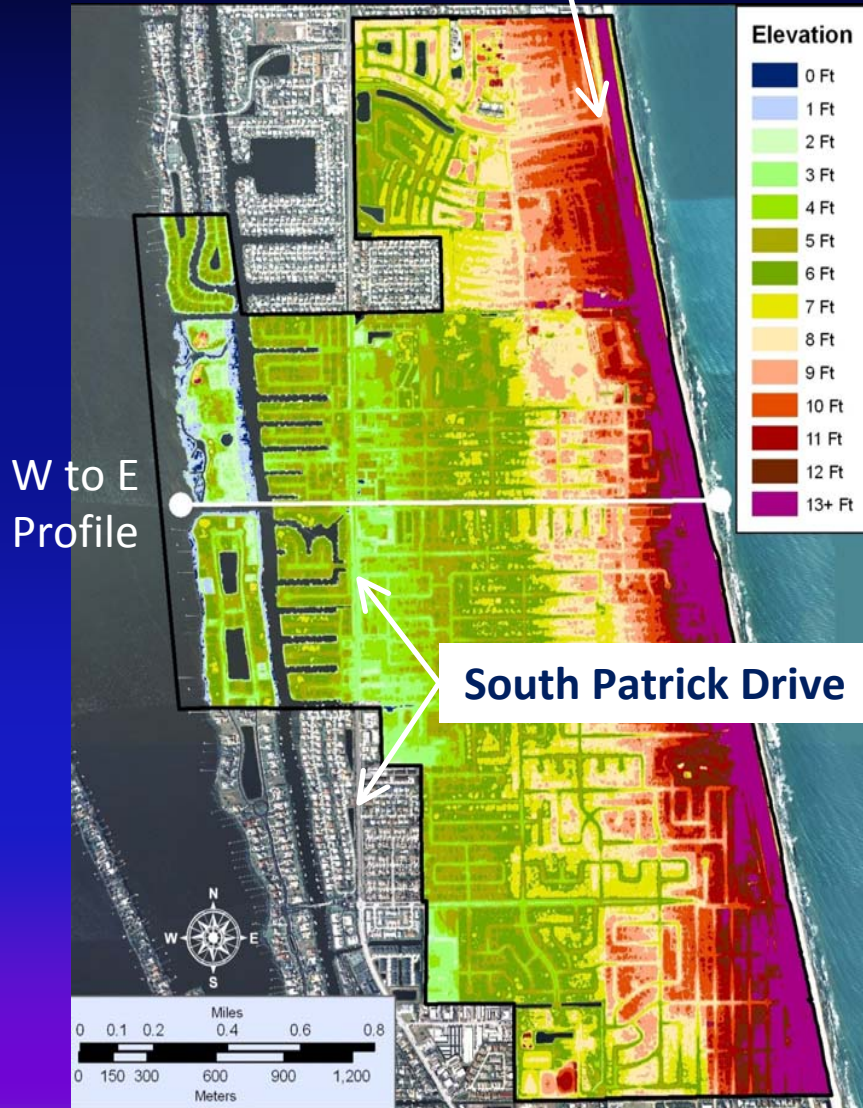
- Establish “current conditions” (i.e., water level elevation, datum)
- Inundate using most recent estimates of sea-level rise

oQuantify impact to municipal landscape and assets

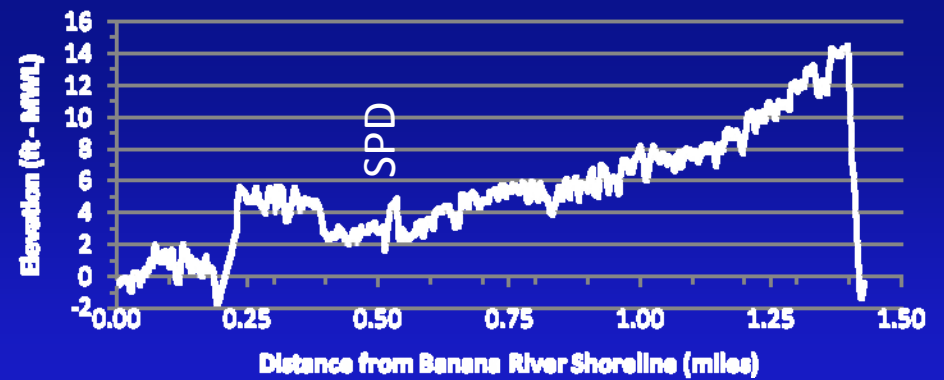
- Define “impact” for features mapped as a point, line, or polygon
- Document flooding of landscape (i.e., neighborhoods) and assets (i.e., roads) as a function of sea-level elevation



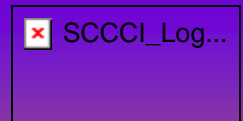
Highway A1A



Profile along Roosevelt Ave
West to East



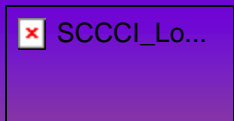
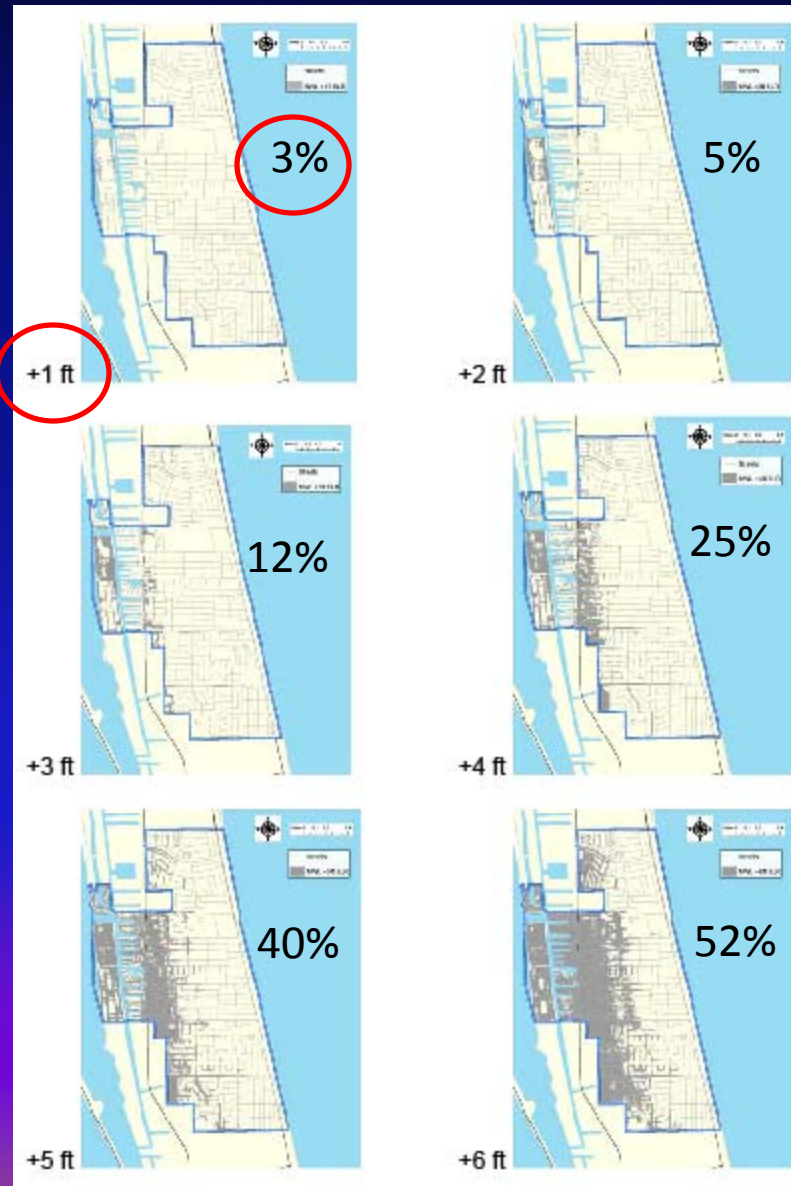
Base map + LiDAR topography



Progressive stages of municipal submergence associated with sea-level rise of +1 ft to +6 ft City of Satellite Beach, Florida

% landscape submerged

Sea-level rise above present



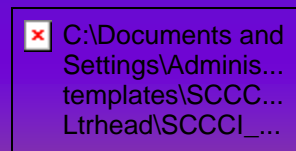
Caveats

- Mean water level exceeded by as much as 1 ft during seasonal weather events and the “fall rise”, hence report distinguishes between seasonal flooding and long term submergence
- Effect of sea-level rise on storm surge is not quantified
- Extent of upland flooding does not reflect rise in water table
- All shorelines and especially the Atlantic Ocean are static

However....

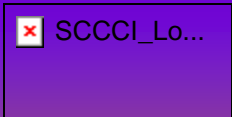
The model’s numerous simplifying assumptions yield a conservative estimate; supplemental work will likely forecast municipal vulnerability at a larger scale and/or faster pace

Regardless, the findings of this pilot project are sufficiently robust to warrant action by the City’s Comprehensive Planning Advisory Committee



How urgent is the need to address *sea-level rise*?

- Based upon sea-level rise projections and City landscape elevations, the “tipping point” between relatively benign impacts and those that disrupt important elements of the municipal landscape is +2 ft (0.6 m) above present
- Seasonal flooding to an elevation of +2 ft is forecast to begin around 2050
- Thus, the City has about 40 years to formulate and implement a plan to address sea-level rise



Task 3 - Collaborate with City during review and update of applicable planning documents: Prolog

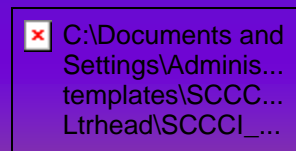
There are three basic options in responding to sea-level rise (Deyle and others 2007):

- (1) Protect (aka Defend)
- (2) Retreat
- (3) Accommodate

According to the EPA (Titus 1991), choosing among these response options will likely be based upon:

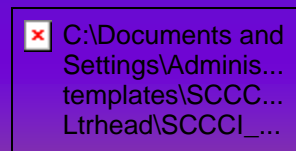
- (1) an assessment of the value of the threatened assets (i.e., the built and natural environments) and
- (2) the cost of protecting these assets

Recently, the EPA predicted most of the Atlantic coast is developed to the extent the most likely response will be to protect or defend threatened coastal assets (Titus and others 2009)



Think Locally.....

- The response options forecast by the EPA for the mid-Atlantic region may not be applicable to peninsular Florida or the City of Satellite Beach
 - The peninsula consists of different geologic materials (unconsolidated sand and porous limestone); therefore construction of dikes, levees, and seawalls are not viable protection (defend) options
 - 98% of the City is developed; so policies designed to direct new construction towards “high ground” are not viable retreat options
- What are others doing; what are the City’s options?



Sampling of Other Projects Designed to Facilitate Planning for Rising Sea Level

