

# Adapting to Rising Sea Level & Extreme Weather Events: A Florida Perspective

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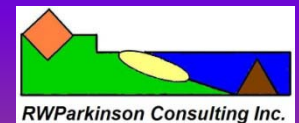
*Space Coast Climate Change Initiative*

7:00 pm to 9:00 pm

June 25, 2009

Community Center

Town of Melbourne Beach, Florida



# Space Coast Climate Change Initiative

[www.spacecoastclimatechange.com](http://www.spacecoastclimatechange.com)

The Space Coast Climate Change Initiative (SCCCI) was established in 2007 and consists of a diverse group of Space Coast residents who believe local government must implement plans to address global climate change .

Recommended actions include:

1. Identifying climate change issues relevant to their constituency
2. Developing sound policies to address these issues
3. Periodic policy updates to reflect the latest and best available information

As an initial objective, the SCCCI seeks to promote sound coastal and ocean policies that address rising sea level and extreme weather.



# Global climate change will have a profound impact on Florida's coastal and marine systems

- Rising sea level will increase erosion of beaches, cause saltwater intrusion into water supplies, inundate coastal marshes and other important habitats, and make coastal property more vulnerable to erosion and flooding
- More extreme weather events, including intense rainfall, floods, droughts, and tropical storms, will alter freshwater flow into estuaries and lagoons, exacerbate polluted runoff and water supply problems, and damage coastal habitats and property

*Florida Coastal and Ocean Coalition 2008*



# Adapting to Rising Sea Level and Extreme Weather Events

## A Florida Perspective

- Most coastal areas are currently managed under the premise that sea-level rise is not significant and that the shorelines are static or can be fixed in place by engineering structures
- The new reality of sea-level rise and extreme weather due to climate change requires a new style of planning and management to protect resources and reduce risk to humans

*USCCSP 2009*



# Adapting to Rising Sea Level and Extreme Weather Events

## What Should Be Done?

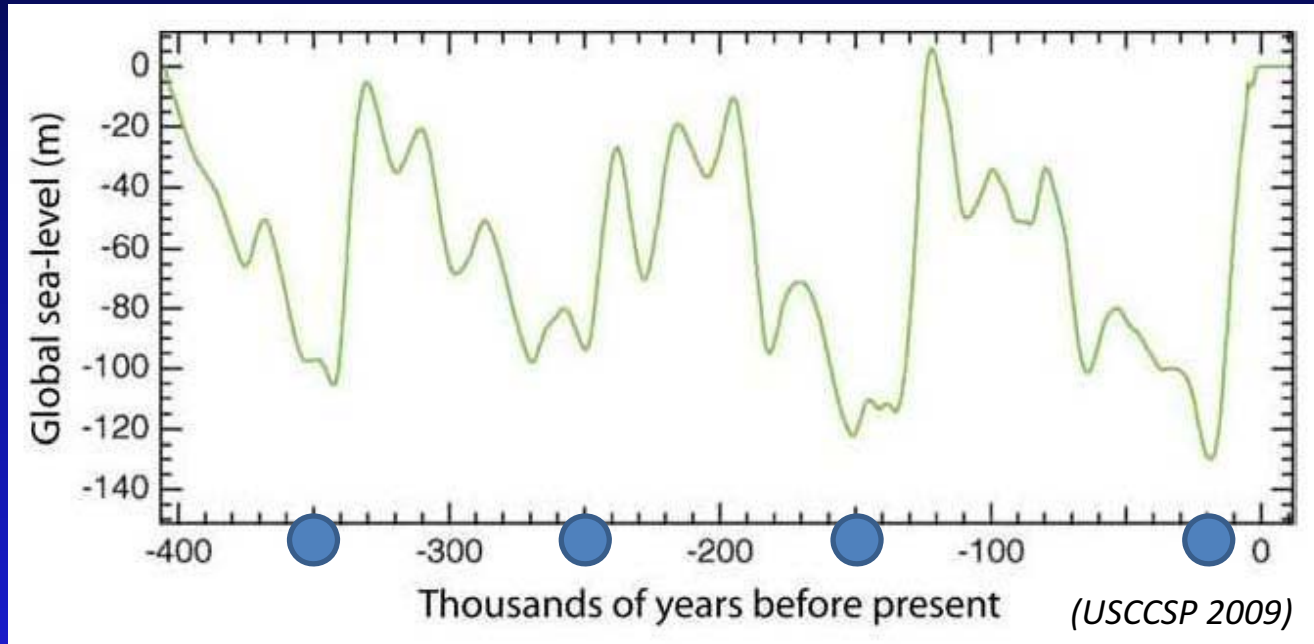
### The Role of Science

- Assess *existing* coastal vulnerability to address *short term (years)* management issues
- Model *future* landscape change and develop sustainable plans to address *long term (decades)* planning and management issues

### Information Transfer

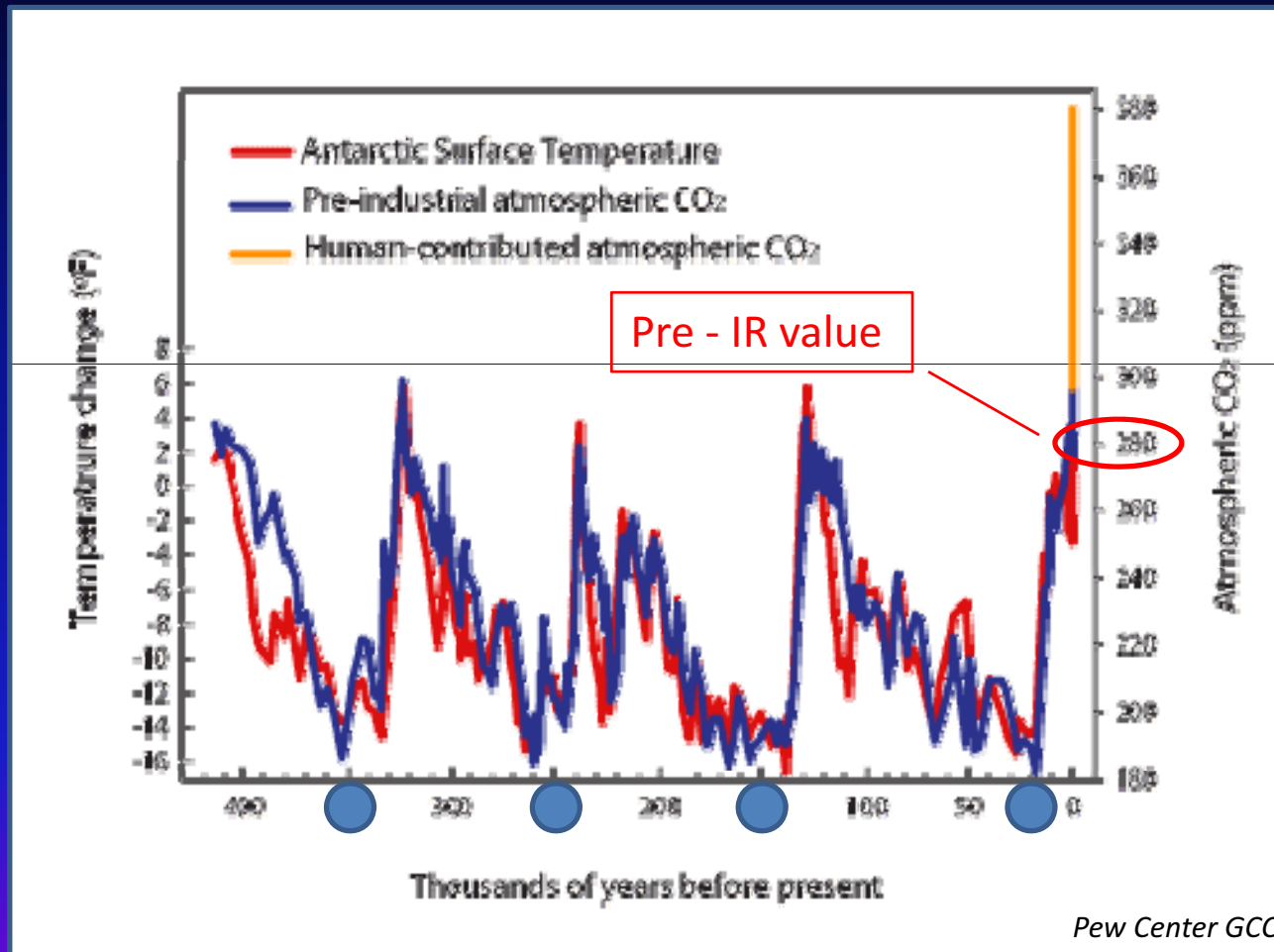
- Planners, managers, and elected officials must have access to science and scientists to ensure their decisions are based upon the best available information

# Plot of large variations in global sea level elevation over past 400,000 years and associated glacial and interglacial cycles



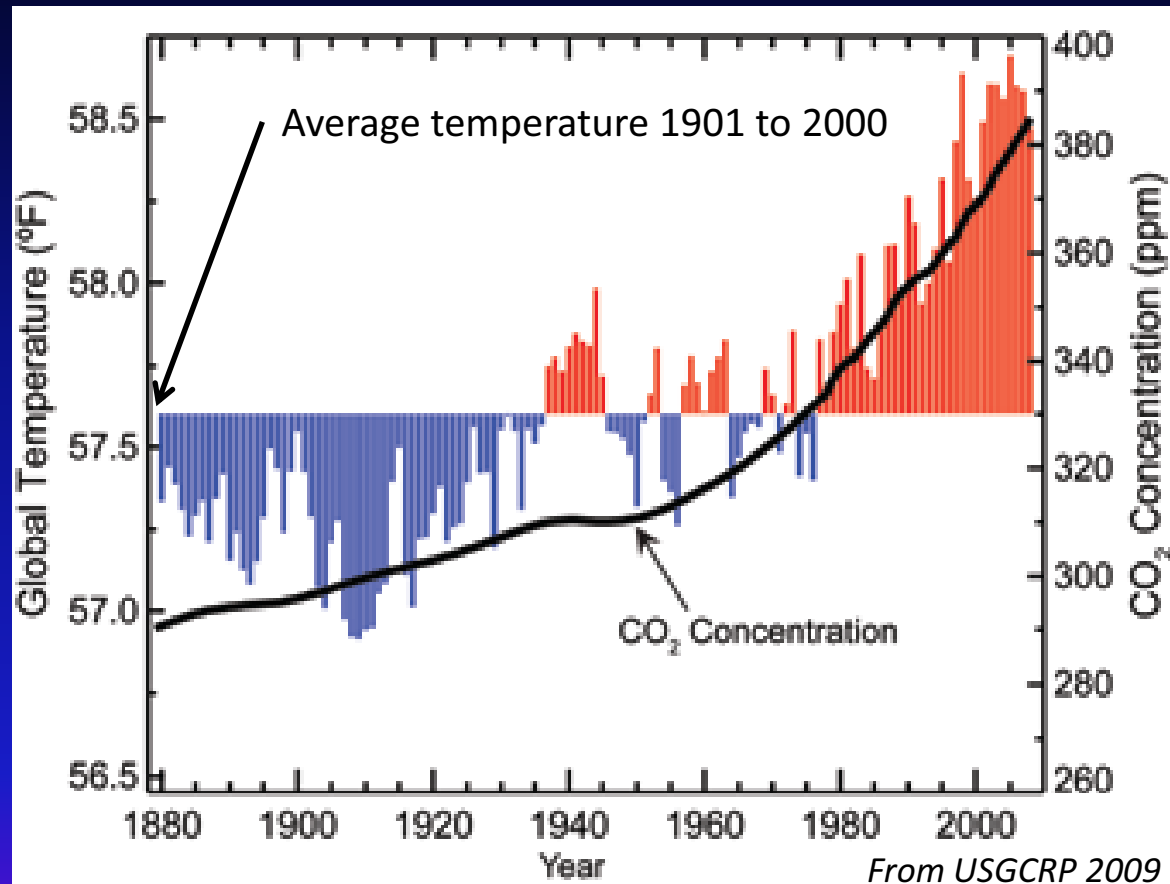
Glacial interval ●

# Covariance of temperature and CO<sub>2</sub> (and sea level) evident until Industrial Revolution (~1760 to 1830)

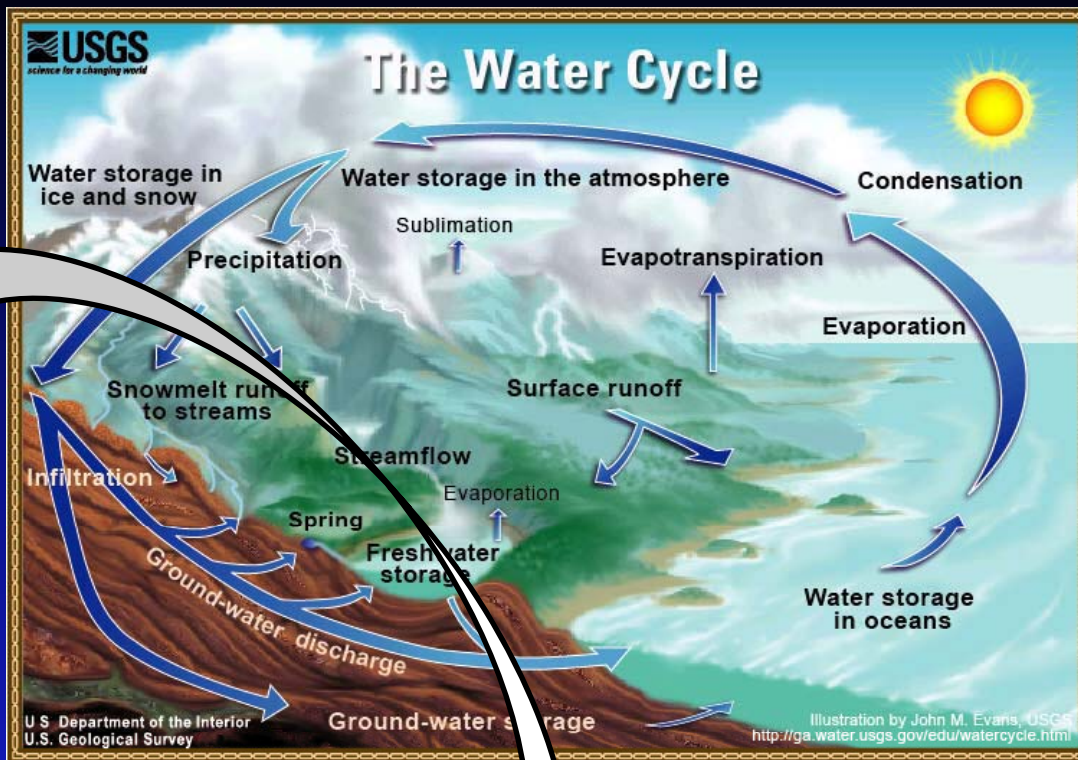


Glacial interval 

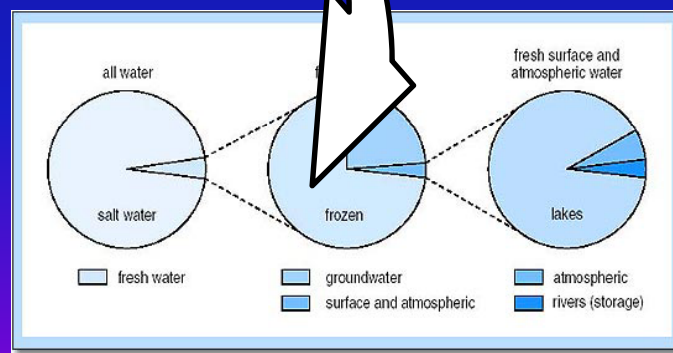
# Historical Trends in Global Temperature and Carbon Dioxide







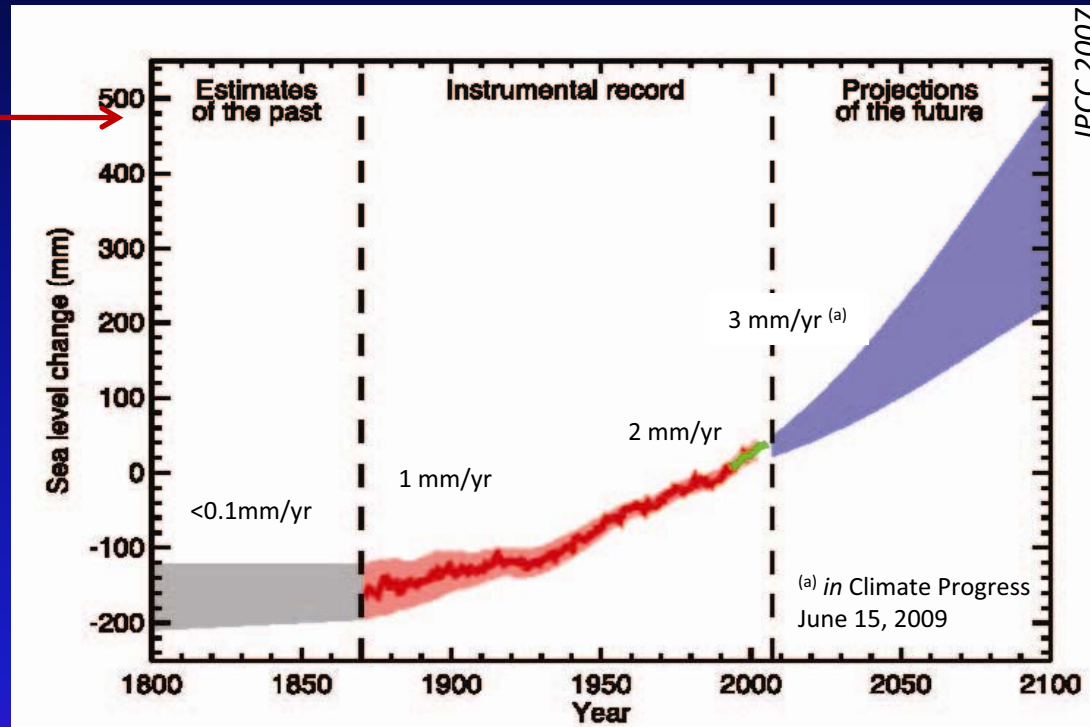
91% of this ice is in Antarctica; an ice sheet not considered by the IPCC when forecasting sea level rise



# Rate of sea-level rise begins to increase at end of Industrial Revolution

↑  
Best guess is now 3 to 5 ft of rise by 2100

1.5 ft →



Recent forecasts suggest sea level may rise as much as or more than 2 meters by the year 2100

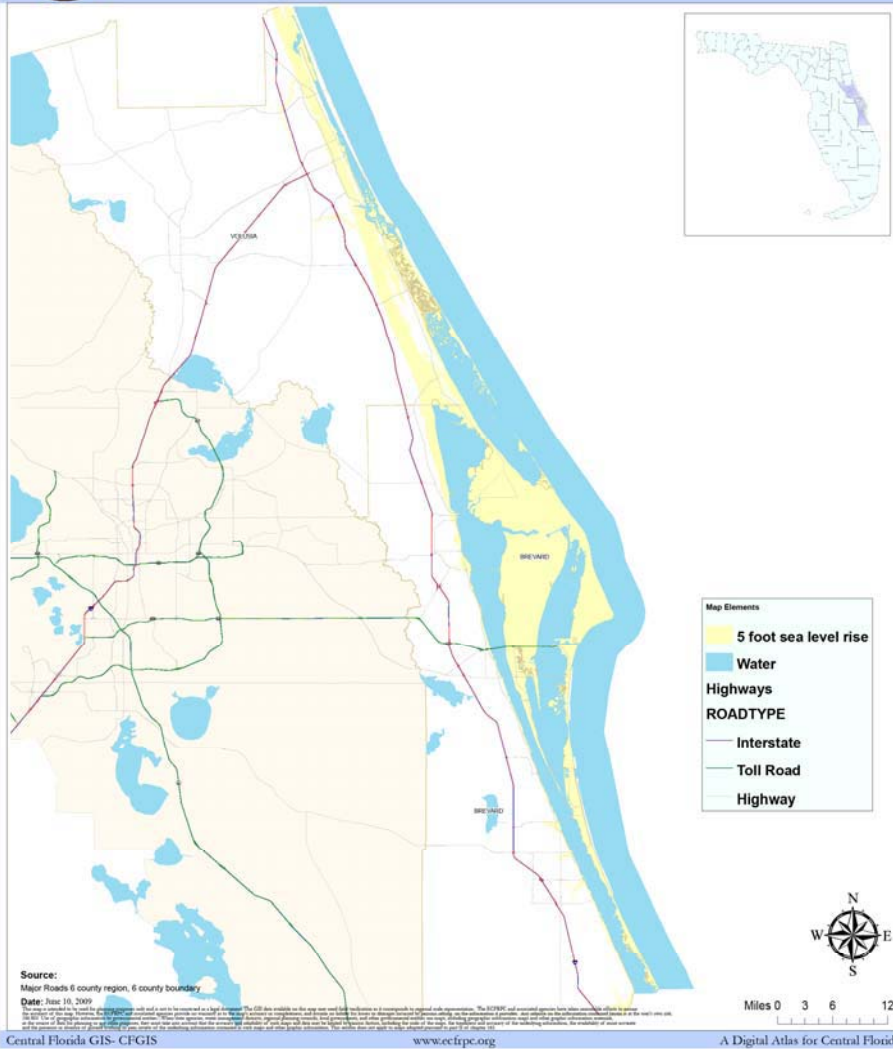
(*Science* 5 September 2008)



# Sea Level Rise

Volusia and Brevard Counties

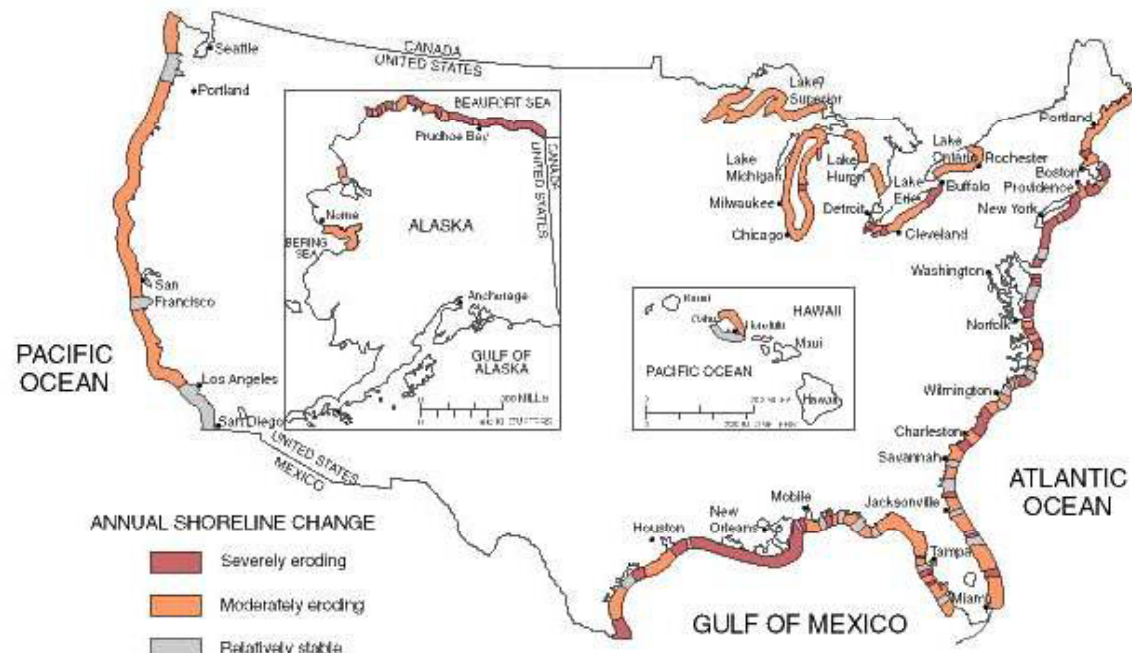
Map from ECFRPC 2009



A five foot rise in sea level will submerge most of the coastal zone including inland waterways.

The new shoreline will coincide with the Atlantic Coastal Ridge; itself a shoreline 120,000 years ago.

## But what about lower estimates of rising sea level?



Graphic depiction of United States shoreline change over the past century. All 30 coastal states are experiencing overall erosion at variable rates. *USCCSP 2009*

## A Florida Perspective

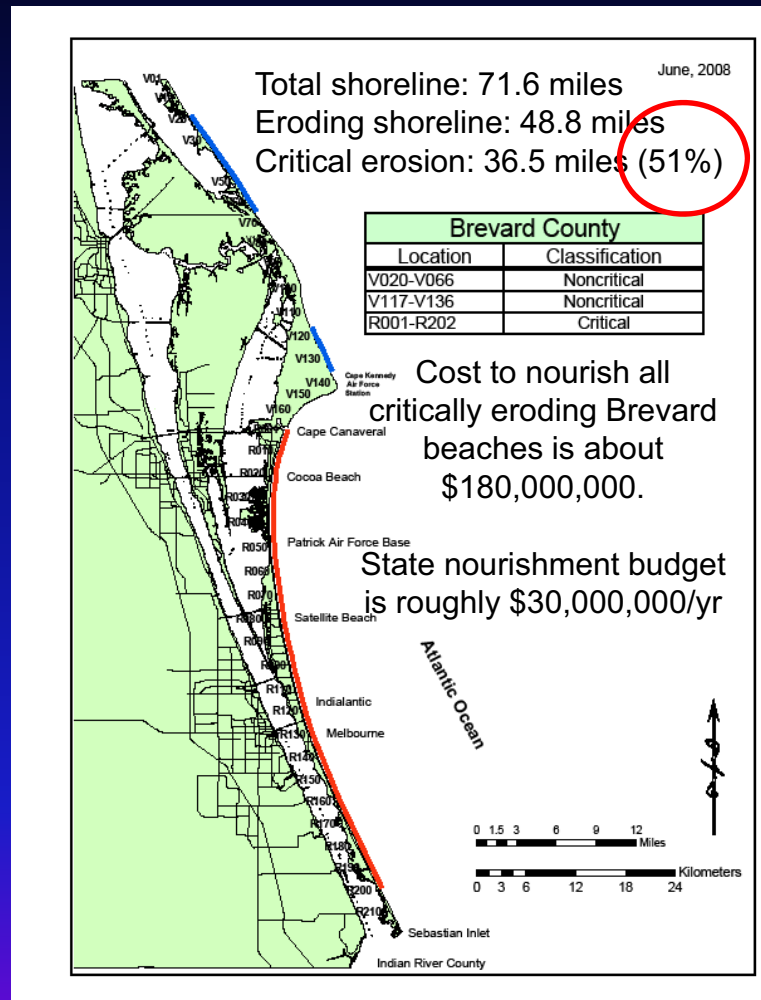
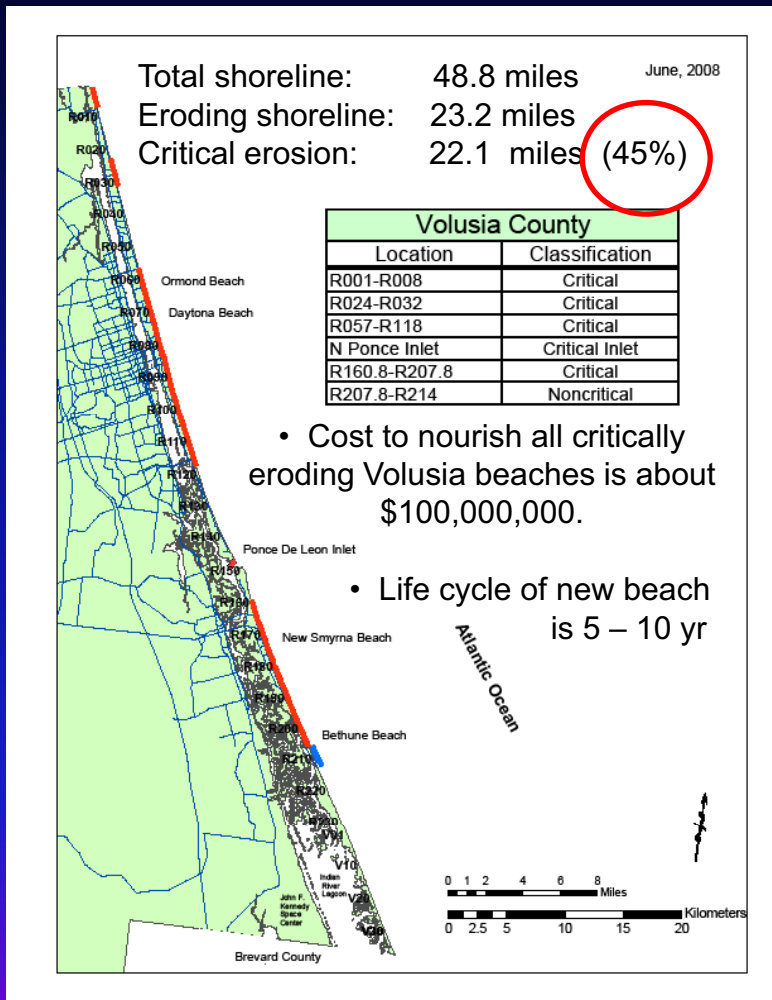
- 590 miles of Florida's 825 miles of sandy shoreline are eroding
- 492 miles of this shoreline are "critically" eroding
- About 200 miles of eroding shoreline are actively "managed" via construction of shore protection projects (i.e., dredge & fill, dune restoration)
- As of 2002 Florida had constructed the greatest number of dredge & fill (aka beach nourishment) projects along the Atlantic and Gulf coasts: 140+
- Dredge and fill construction costs (1964 – present) have exceeded \$700,000,000 and now average more than \$4,000,000 per mile!

*Data from Clark 1989, FDEP 2008, NAP 1990, NOAA 2009*

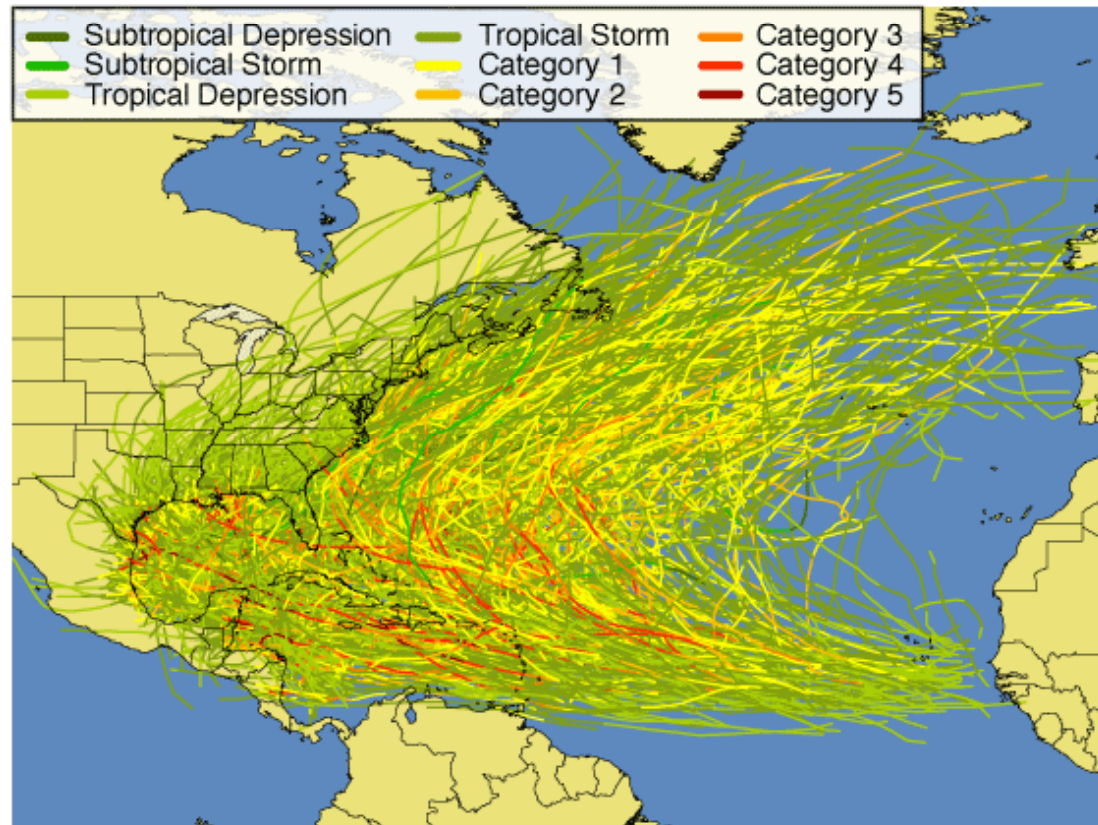




# Volusia and Brevard County Eroding Shoreline (FDEP 2008)



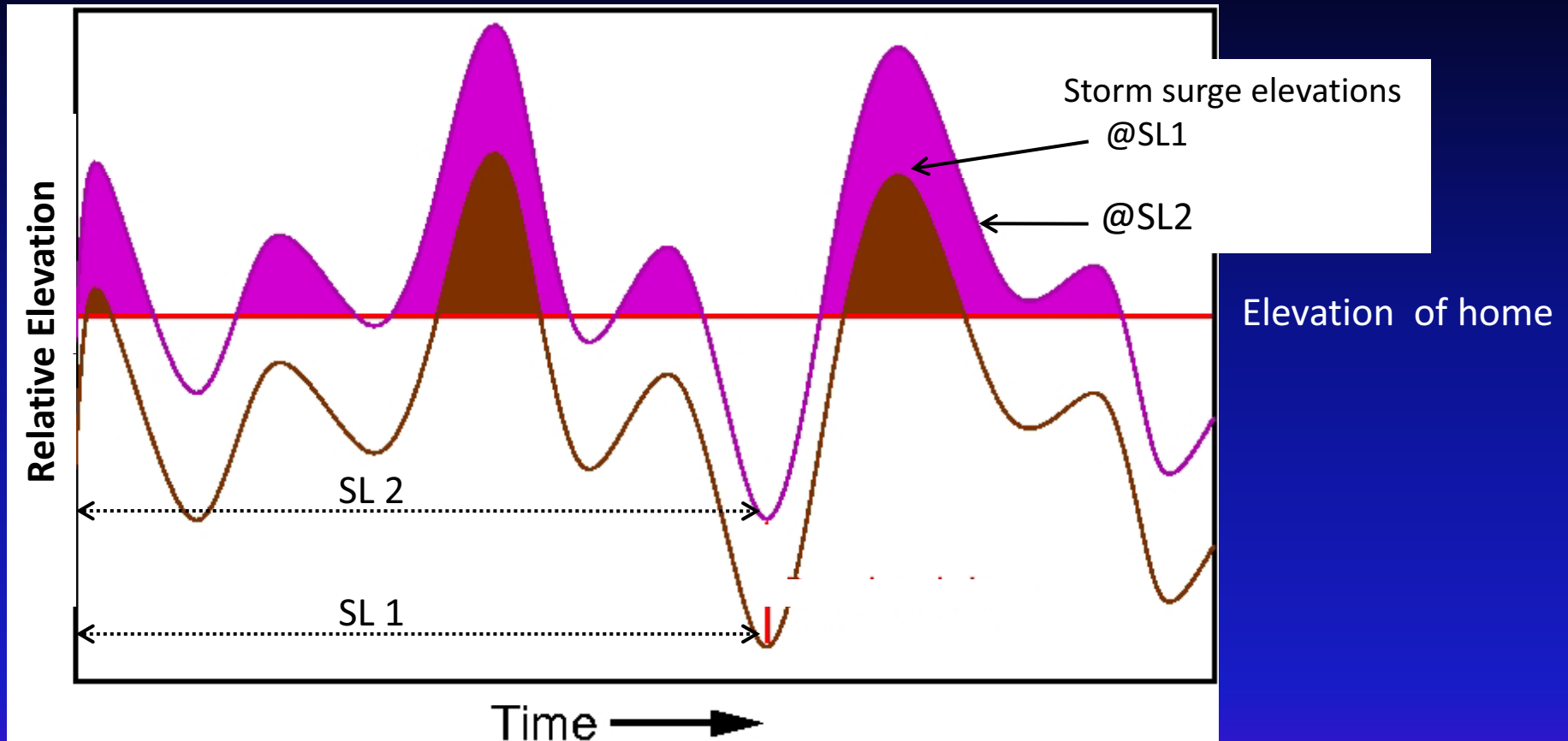
Continued use of beach compatible sand from offshore sources is unsustainable; this non-renewable resource will likely be depleted in our lifetime.



USGS

Graphic summary of Western Atlantic storm tracks as recorded during historical time. Climate change will increase the frequency and magnitude of these events

## Illustrating the effect of rising sea level on hurricane flooding using identical storm seasons



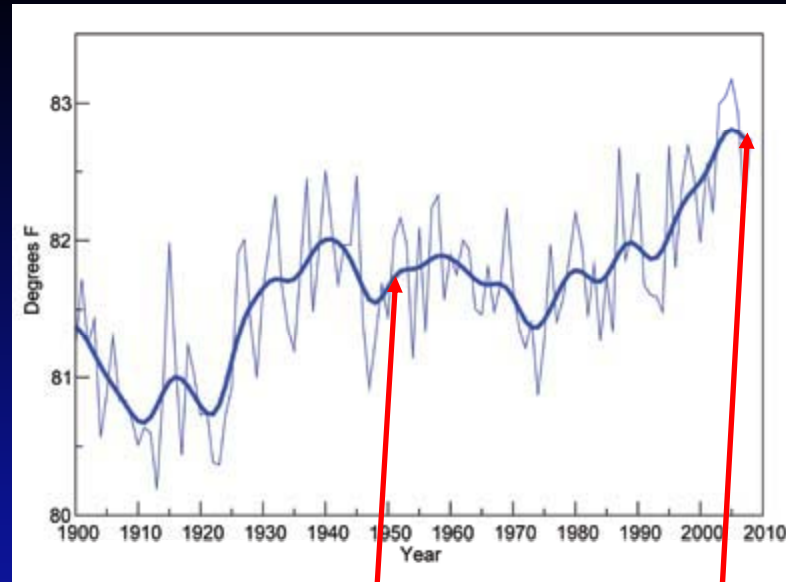
However, the warming of Atlantic Ocean equatorial surface water will increase the frequency, duration, and magnitude of extreme weather events



Sea Surface Temperature (SST) in main development region of Atlantic hurricanes (August through October, 1900 to 2008).

Higher SST in this region of the ocean has been associated with more intense hurricanes.

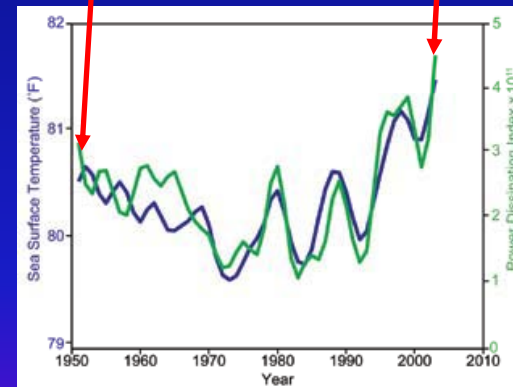
(USGCRP 2009)



Observed relationship between SST (blue) and *Hurricane Power* (green) in the North Atlantic Ocean.

Where  $HP \sim$  frequency, intensity, duration

(USGCRP 2009)



# What Should Be Done?

## The Role of Science

- Assess *existing* coastal vulnerability to address *short term* management issues
- Model *future* landscape change and develop sustainable plans to address *long term* planning and management issues

## Information Transfer

- Planners, managers, and elected officials must have access to science and scientists to ensure their decisions are based upon the best available information

# An Assessment of Existing Coastal Vulnerability

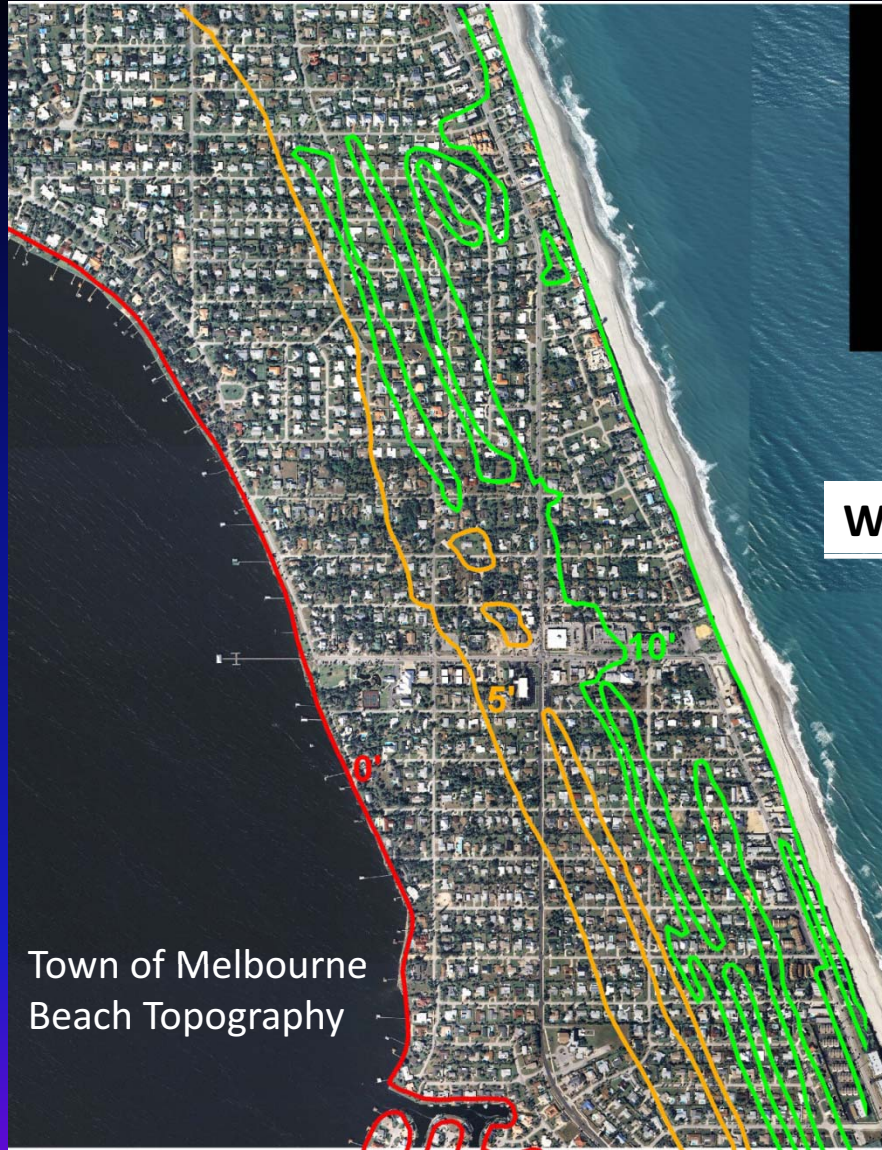
## EPA 's Climate Ready Estuaries Program City of Satellite Beach Pilot Project

### Objectives:

1. Acquire detailed map of coastal topography
2. Model rising sea level @1 ft increments
3. Quantify impacts on residents and infrastructure
4. Formulate response
  - a. Stakeholder meetings
  - b. Update planning documents
  - c. Education and outreach programs

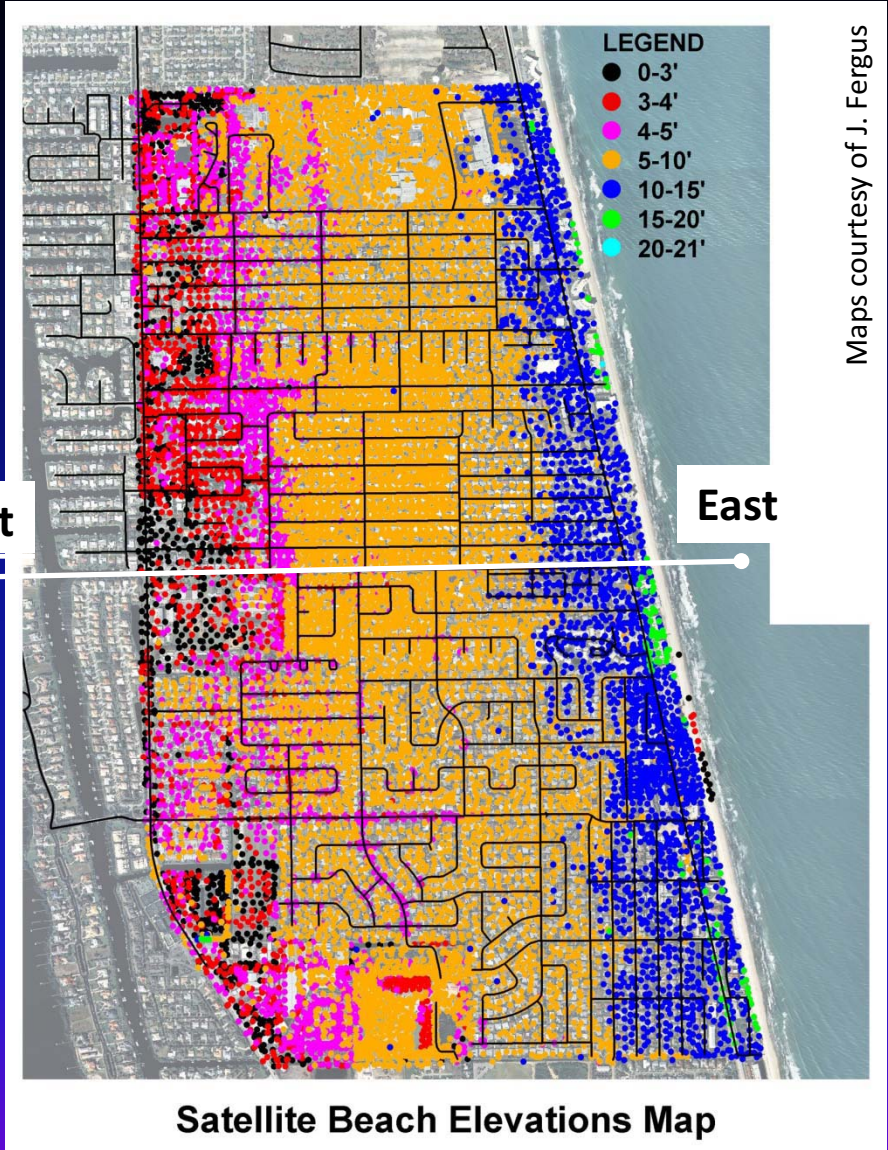






West

East



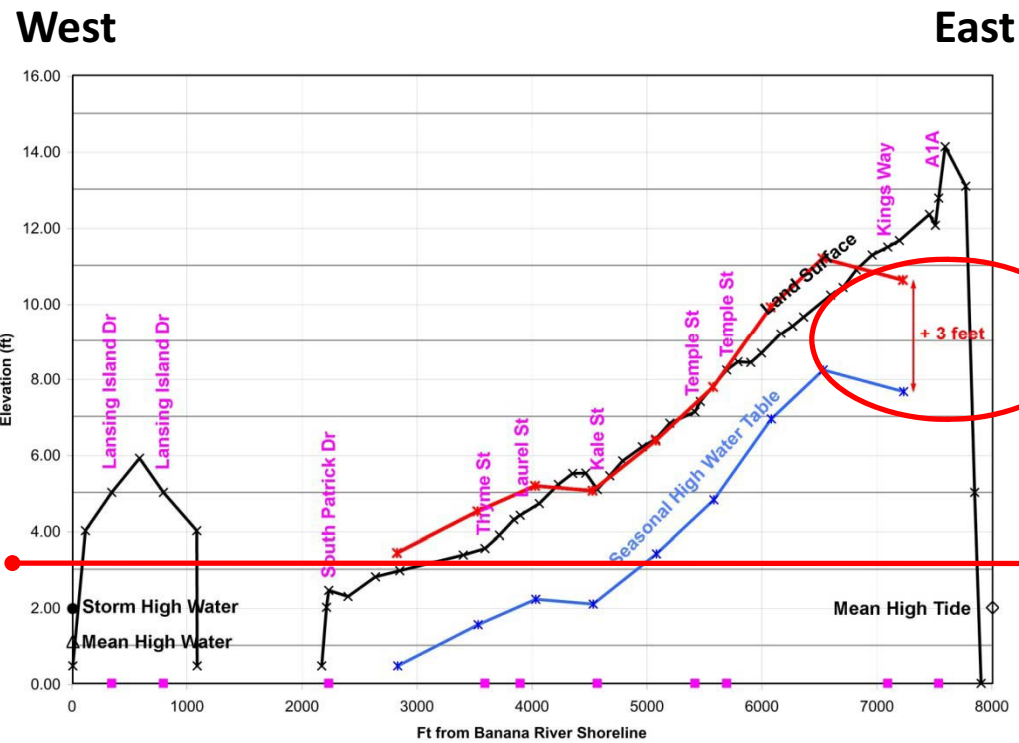
Maps courtesy of J. Fergus



# Brevard County Barrier Island Topography



3 ft sea level rise



3 ft rise in GWT

### Island Cross Section Along Cassia Boulevard

Provided by J. Fergus

#### Observations:

1. Largest land loss by submergence is along *lagoon* margin of barrier island; Atlantic shoreline *erosion* not considered.
2. Concomitant rising water table inundates most remaining land behind Atlantic coastline.





## Mapping the coastal zone using LIDAR + GPS+ GIS



Detailed elevation (<30 cm) maps can be constructed and the surface then flooded to emulate rising sea level

# What are the adaptation “choices” upon completing a vulnerability assessment; how does a city respond?

## Shore Protection

- Utilize coastal engineering structures designed to protect land from inundation, erosion, flooding
- Short-term solution when sea level is at lower elevations or rates of rise
- Keep shoreline at a fixed position - seawalls, bulkheads, revetments
- Protect against flooding or permanent inundation - dikes, dunes

## Adaptation choices (continued)

### Managed Withdrawal

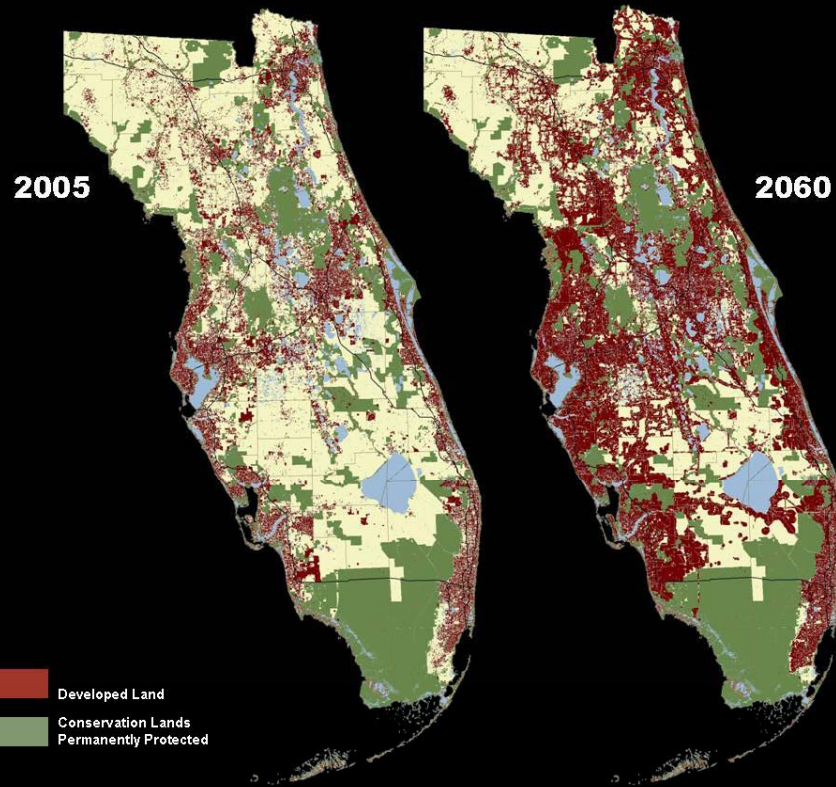
- Minimize hazards and environmental impacts by removing or diverting development from the most vulnerable areas
- Long-term solution to higher sea-level elevations or rates of rise
- Along *developed* coasts: relocation of structures, buyout programs, rolling easements
- Along *undeveloped* coasts: conservation easements, environmental land acquisition programs



# Adapting to Rising Sea Level and Extreme Weather Events

## Managed Withdrawal

Developed Land and Permanent Conservation Lands



Florida 2060: A Research Project of 1000 Friends of Florida

By the year 2060 an additional seven million acres of Florida landscape will be subject to urban development.

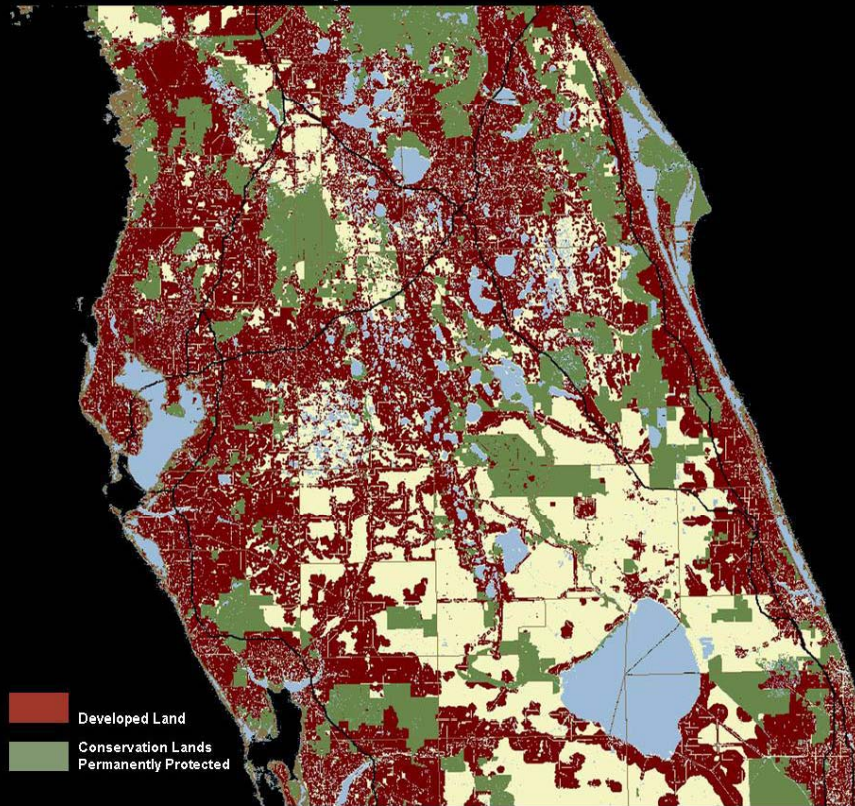
Hence, the impact of climate change will depend on how quickly we adapt and mitigate.

The longer we wait the fewer the choices and the graver the consequences.

# Adapting to Rising Sea Level and Extreme Weather Events

## Managed Withdrawal

2060 Developed Lands and Permanent Conservation Lands



Developed Land  
Conservation Lands  
Permanently Protected



Florida 2060: A Research Project of 1000 Friends of Florida

Towards 2060 urban development will be concentrated along the Florida coastline.

Unencumbered development will complicate managed withdrawal; regional planning must begin today.

## Why we can't wait

While there is still uncertainty regarding the details of rising sea level and extreme weather, comprehensive plans and associated development decisions are being made today which commit public and private investment in real estate and associated infrastructure.

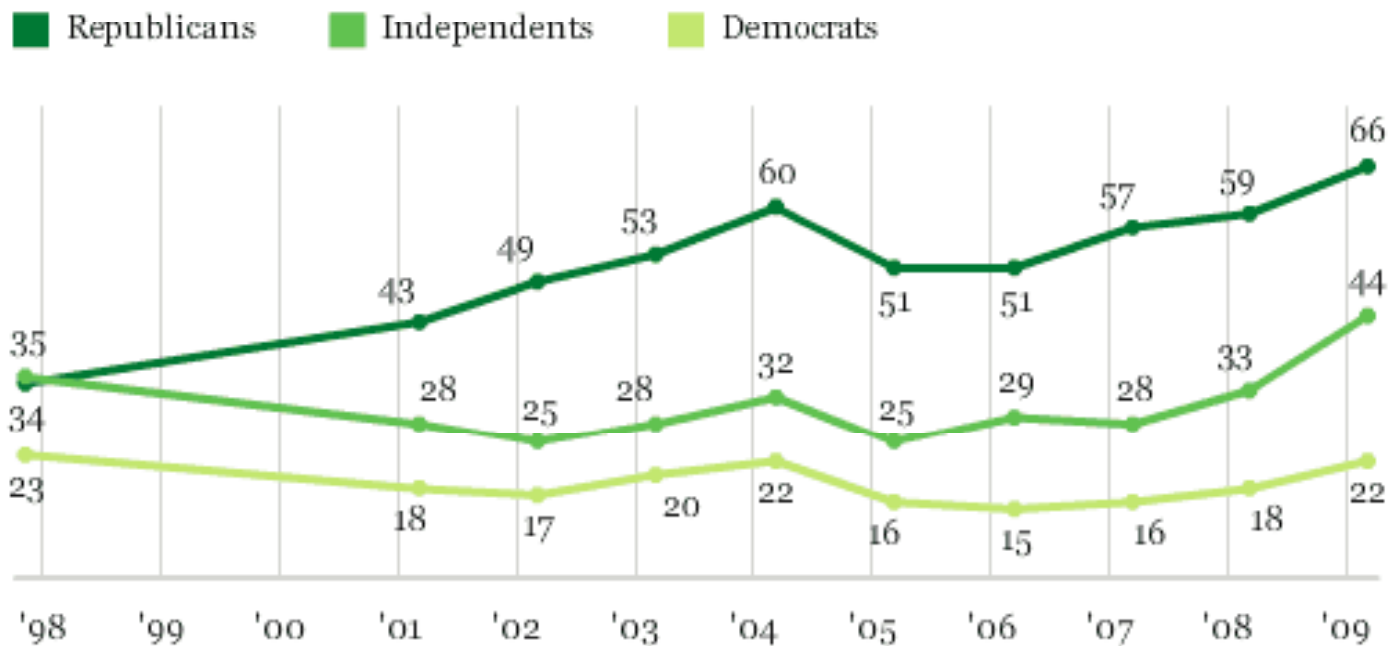
With a design life of 30 yrs to 100 yrs, many of these investments are on a collision course with the consequences of climate change and the resulting impacts will be significant. *SCCCI 2009*

The tipping point for implementing sound climate change policies with optimal effect is forecasted to pass during the next decade. *Lowe et al. 2009 in EOS 90(21)*



# Politicizing the Science of Climate Change

Percentage Saying News of Global Warming Is Exaggerated, by Party ID



GALLUP POLL

[www.climateprogress.com](http://www.climateprogress.com)



## Key Findings

### 1. Global warming is unequivocal and primarily human-induced.

Global temperature has increased over the past 50 years. This observed increase is due primarily to human-induced emissions of heat-trapping gases. (p. 13)

### 2. Climate changes are underway in the United States and are projected to grow.

Climate-related changes are already observed in the United States and its coastal waters. These include increases in heavy downpours, rising temperature and sea level, rapidly retreating glaciers, thawing permafrost, lengthening growing seasons, lengthening ice-free seasons in the ocean and on lakes and rivers, earlier snowmelt, and alterations in river flows. These changes are projected to grow. (p. 27)

### 3. Widespread climate-related impacts are occurring now and are expected to increase.

Climate changes are already affecting water, energy, transportation, agriculture, ecosystems, and health. These impacts are different from region to region and will grow under projected climate change. (p. 41-106, 107-152)

### 6. Coastal areas are at increasing risk from sea-level rise and storm surge.

Sea-level rise and storm surge place many U.S. coastal areas at increasing risk of erosion and flooding, especially along the Atlantic and Gulf Coasts, Pacific Islands, and parts of Alaska. Energy and transportation infrastructure and other property in coastal areas are very likely to be adversely affected. (p. 111, 139, 145, 149)

### 10. Future climate change and its impacts depend on choices made today.

The amount and rate of future climate change depend primarily on current and future human-caused emissions of heat-trapping gases and airborne particles. Responses involve reducing emissions to limit future warming, and adapting to the changes that are unavoidable. (p. 25, 29)

# What should be done?

A comprehensive state strategy must be established to confront our changing climate.

Local growth management plans, building and zoning ordinances, storm-water management policies and etc. must be updated to reflect this new reality.

Specific recommendations on how best to proceed include:

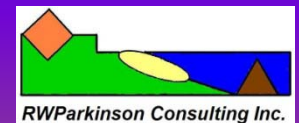
- (1) acknowledge the potential threat of climate change, including rising sea level and extreme weather
- (2) incorporate “tipping points” that mandate specific action(s) when reached
- (3) discontinue (re)building in vulnerable areas
- (4) establish high-risk land acquisition programs to facilitate managed withdrawal concomitant with enhancing green space and storm buffer zones
- (5) prohibit the installation of shore protection structures
- (6) wean coastal communities off beach re-nourishment
- (7) identify well-defined corridors for inland/upland migration of urban and natural habitat





## What you can do?

- **Show up** – demonstrate your support for climate change initiatives by attending public events or forums
- **Get smart** – continue seeking information regarding climate change science, policy, and adaptation
- **Get involved** – express your concerns to “decision-makers” via emails, letters, and the ballot
- **Tell others** – share your ideas with those around you; encourage debate
- **Expand your commitment** – volunteer and/or donate



Don't miss the next SCCCI forum in Satellite Beach on September 15<sup>th</sup>.  
Go to [www.spacecoastclimatechange.com](http://www.spacecoastclimatechange.com) for details.

