

Effects of a Changing Climate on Florida Plant Communities -- et tu, Invasive Species?

Climate Change – a SE Review...

- Driving forces: Greenhouse gasses: CO₂, methane, water vapor

- Resulting changes:

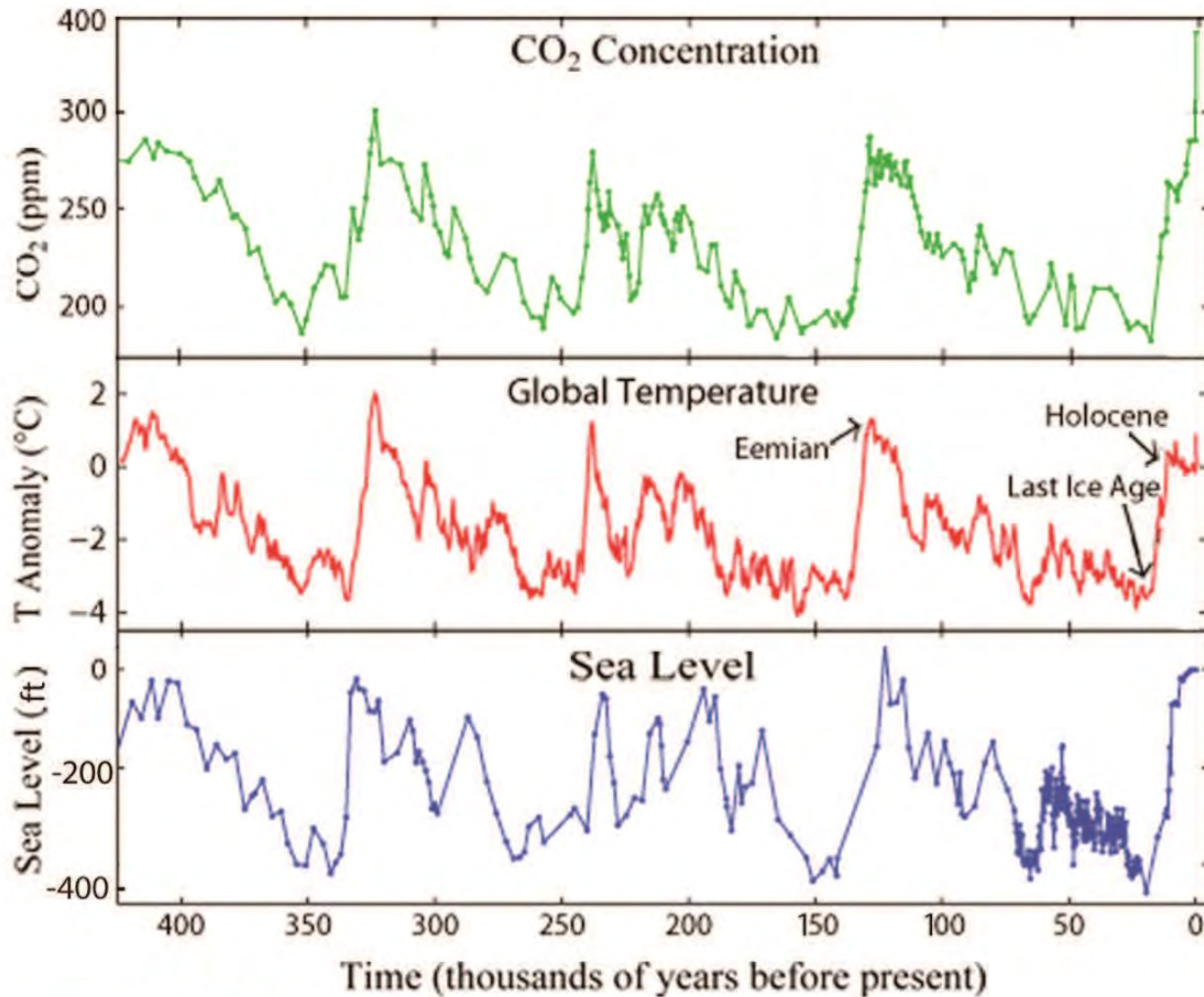
- Ocean Acidification
 - Dissolved CO₂/C sink
 - Coral bleaching
- Temperature –
 - Wacky winters
 - Global warming (+3F. - 2060)
 - Melting glaciers, ice caps



- Sea Level Rise –

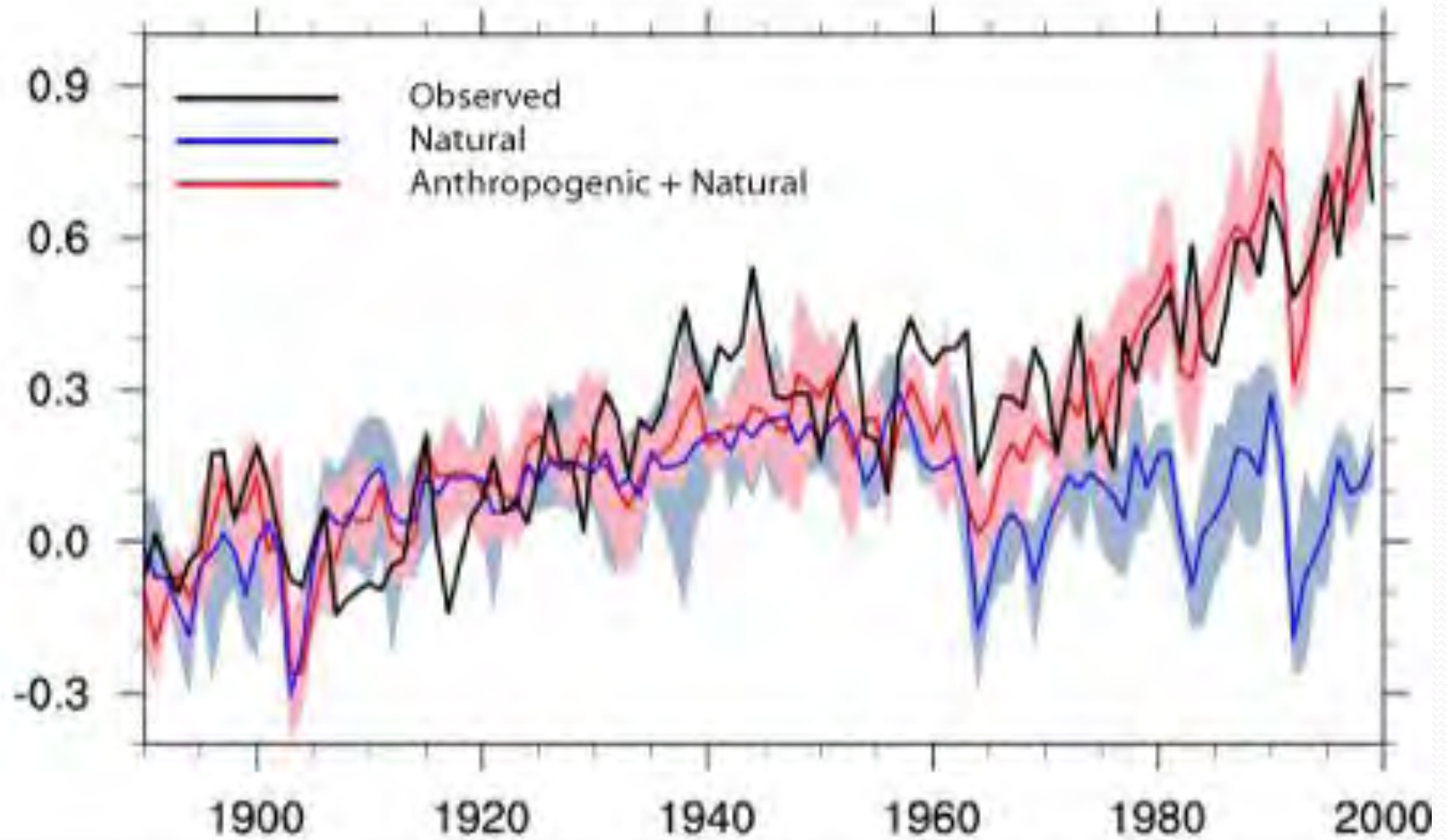
- **40% of the nation's sea level rise will be felt in Florida – lots of coastline**
- **Current estimates: Increase of 9" to 24" by 2060**

Cyclical patterns over time

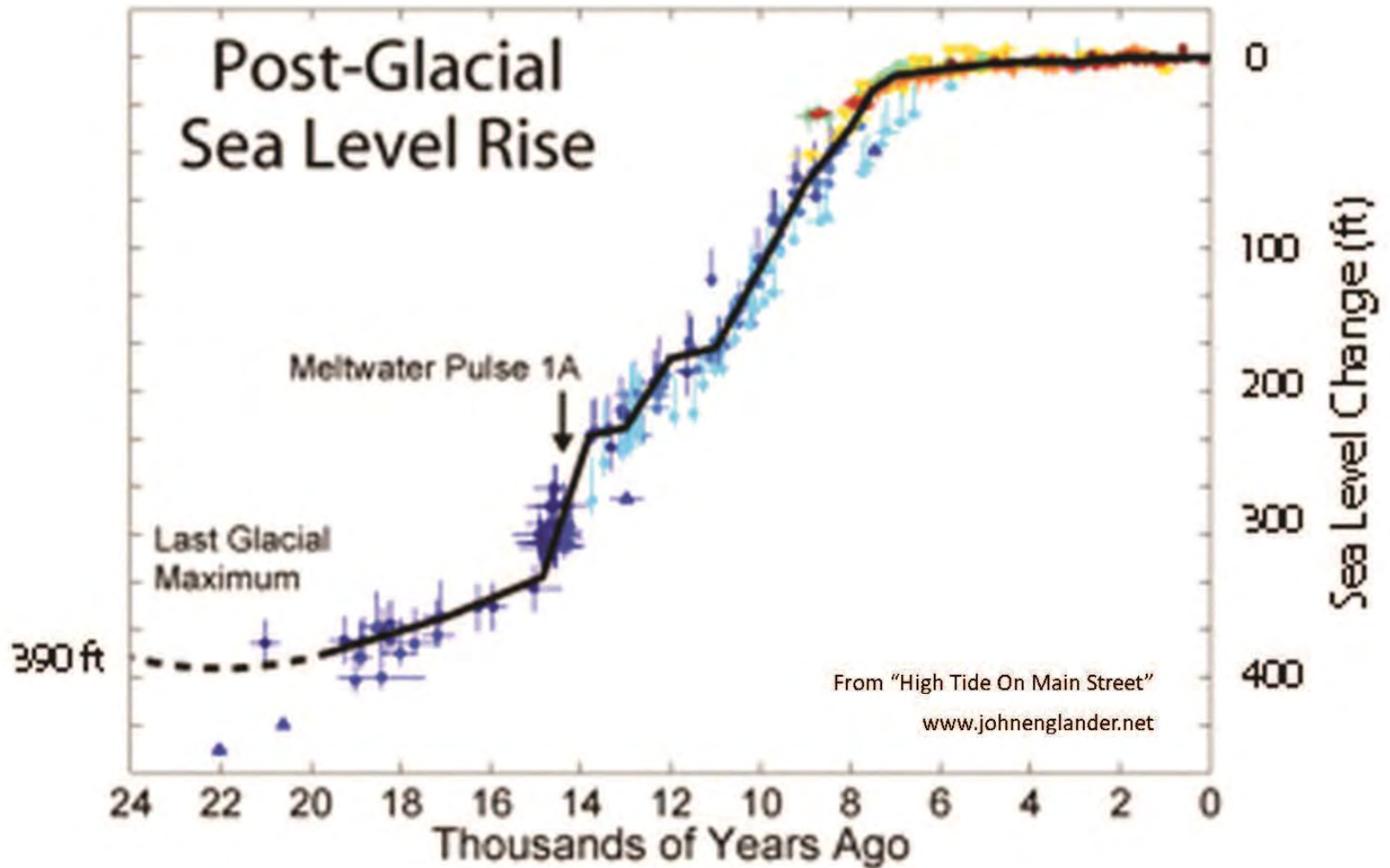


John Englander / "High Tide on Main Street" adapted from Hansen & Sato

Comparison of Modeled and Observed Temperature



Ready for a change?



Ecological Responses to Environmental Change – A Complex Issue

Precipitation

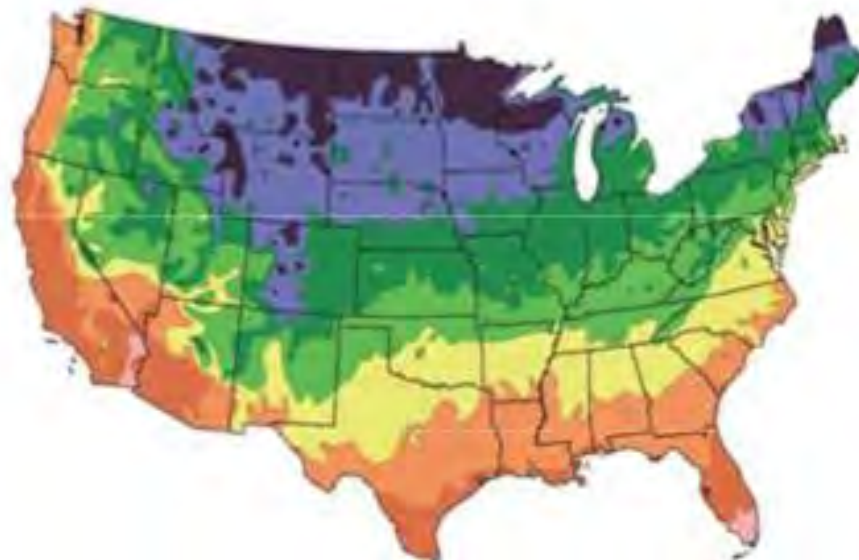
- Evapotranspiration (ET)
- Floods
- Droughts
- Strong storms
 - Hurricanes
 - Erosion

Temperature

- Droughts
- Fire frequency
- Freezes
- Temperate vs. subtropical regions
- Expanded ranges
- Seasonal shifts

Plant Hardiness Zones

1990



2006



Winter low temperatures are a major factor in determining which plants can survive in a particular area. Plant hardiness zones have shifted noticeably northward since 1990, reflecting higher winter temperatures in most parts of the country.

Plant hardiness zones:



Climate Variability May Prompt Later Seasonal Flowering

- Von Holle, 2010

Regional Differences for Native and Non-Native Plants

- Delayed flowering correlates with minimum temperature (T_{min}) variability prior to flowering
- T_{min} variability increased in FL
- T_{min} affected 78-81% flowering times statewide – natives & non-N
- R_1 : Non-Natives flowered 7 days later than natives, related to T_{min}
- R_1, R_7 : Interaction of precip. + T_{max} → slightly earlier flowering
- Warming Trend in Fall in S
- Cooler winter & spring in N
- Lo elevation – greater response to climate change, requires faster response & adaptation

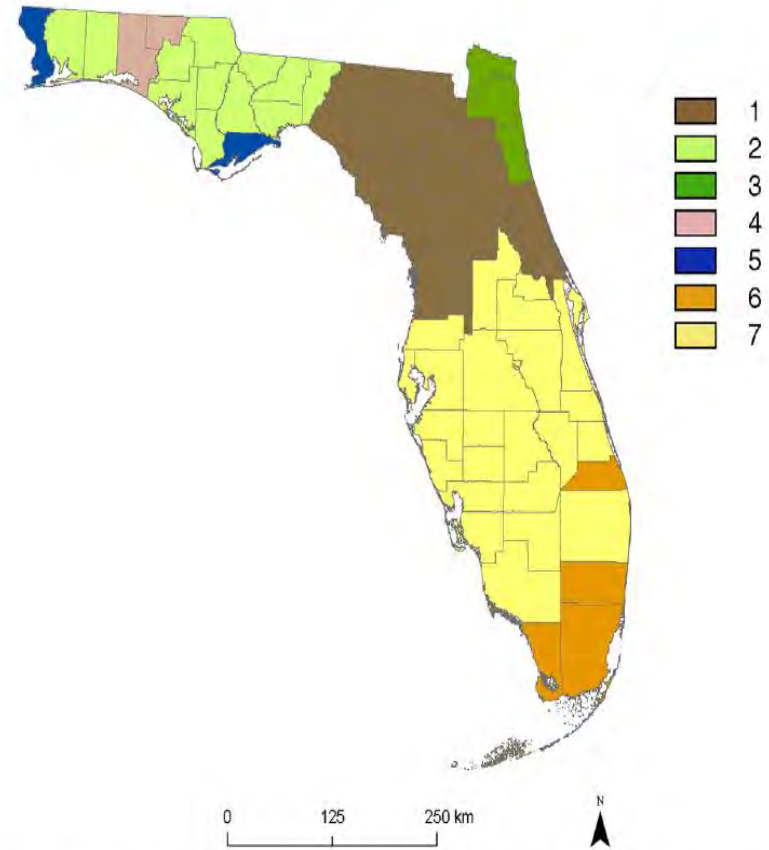
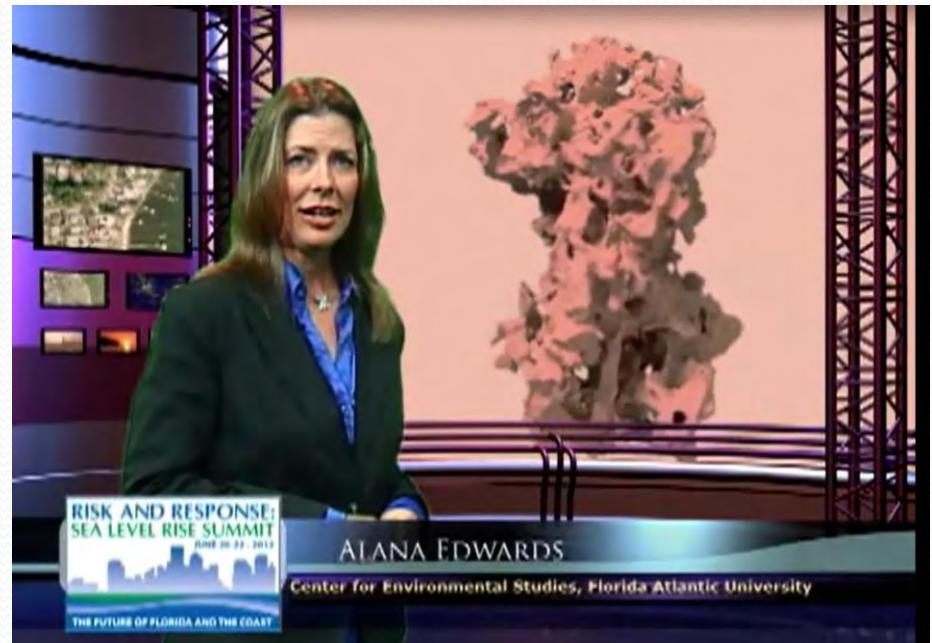


Figure 1. Florida counties grouped by similar climatic conditions. The climatic factors included monthly averages for minimum temperature, maximum temperature, and the precipitation for each county from 1973–2007. These seven clusters of counties had similar historic climatic trends that we treated as separate biogeographic regions for these analyses. See Table S3A for county identity in each biogeographic region. doi:10.1371/journal.pone.0011500.g001

How Might Sea Levels Affect Florida's Plant Communities? ... shifty business

Sea Level Rise

- Rate of Sea Level Rise
- Salt Water Intrusion
- Salt tolerance
- Porous Limestone
- Drainage
- More species at risk of extinction
- Erosion
- Shifting ranges



“... Florida’s porous limestone is like Swiss cheese ...”

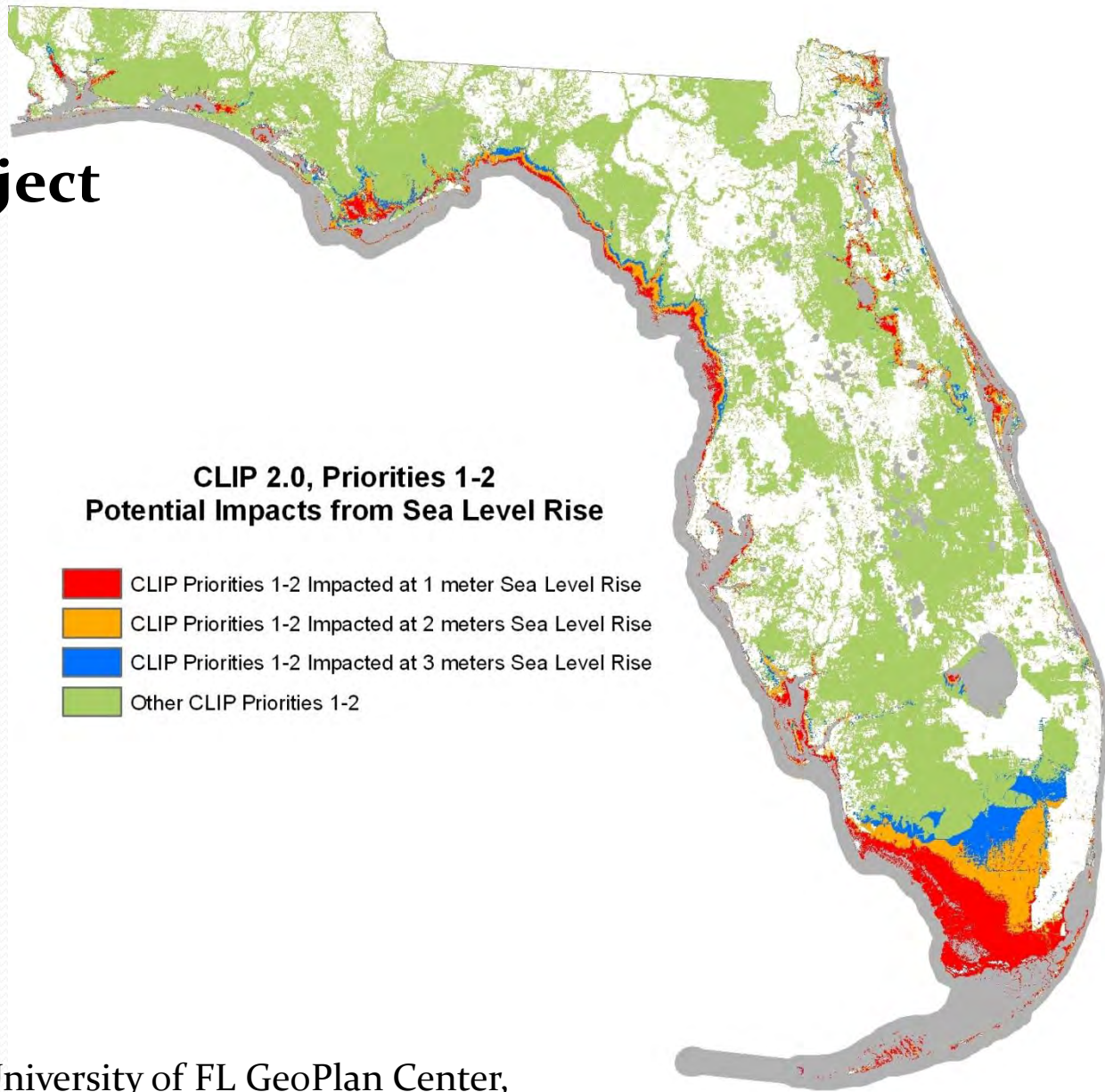
<http://www.ces.fau.edu/SLR2012/media/video-1>

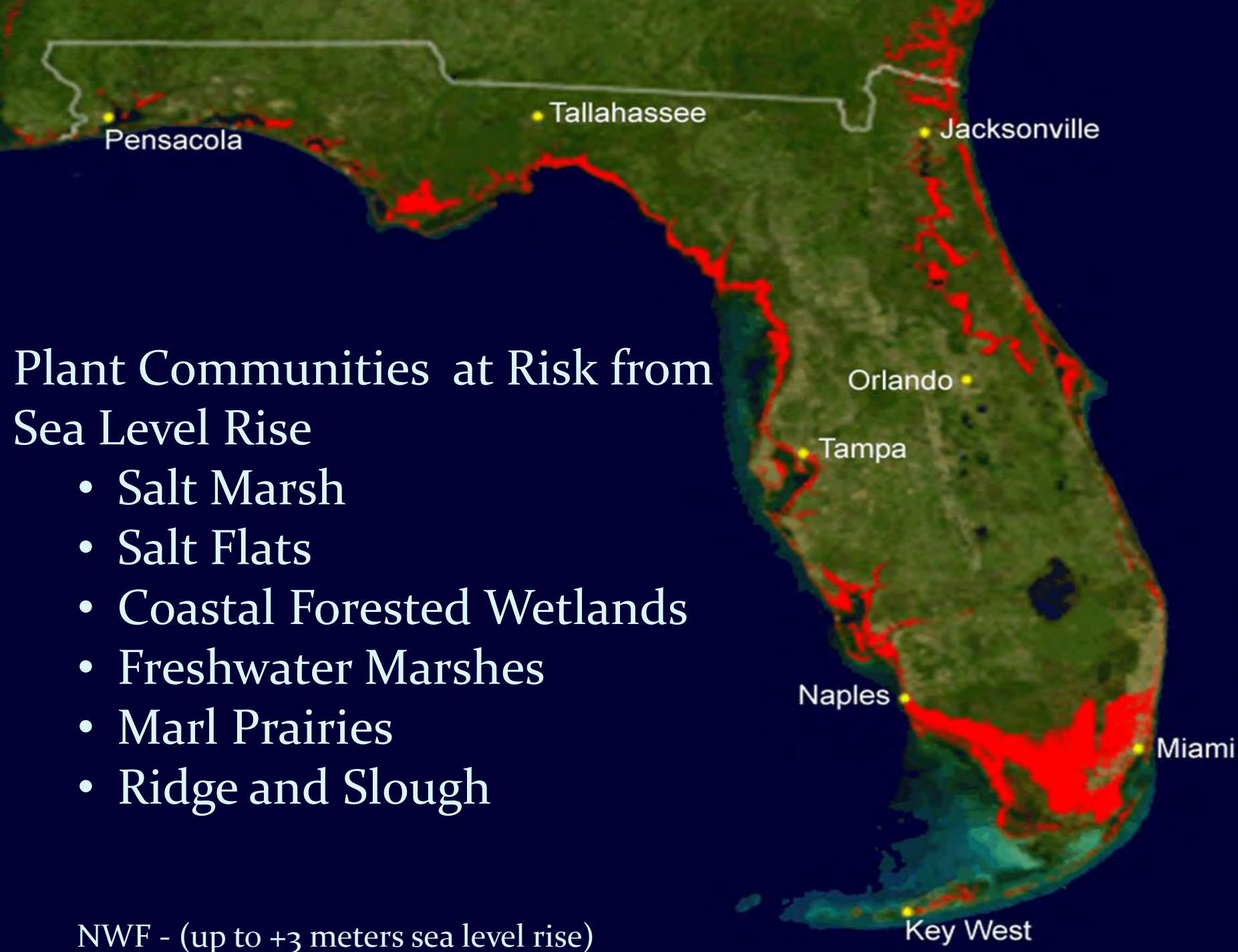
- **CLIP - the Critical Lands and Waters Identification Project**

Greatest Impacts:

- SW FL
- Big Bend
- NE FL

- Florida





Plant Communities at Risk from Sea Level Rise

- Salt Marsh
- Salt Flats
- Coastal Forested Wetlands
- Freshwater Marshes
- Marl Prairies
- Ridge and Slough

NWF - (up to +3 meters sea level rise)

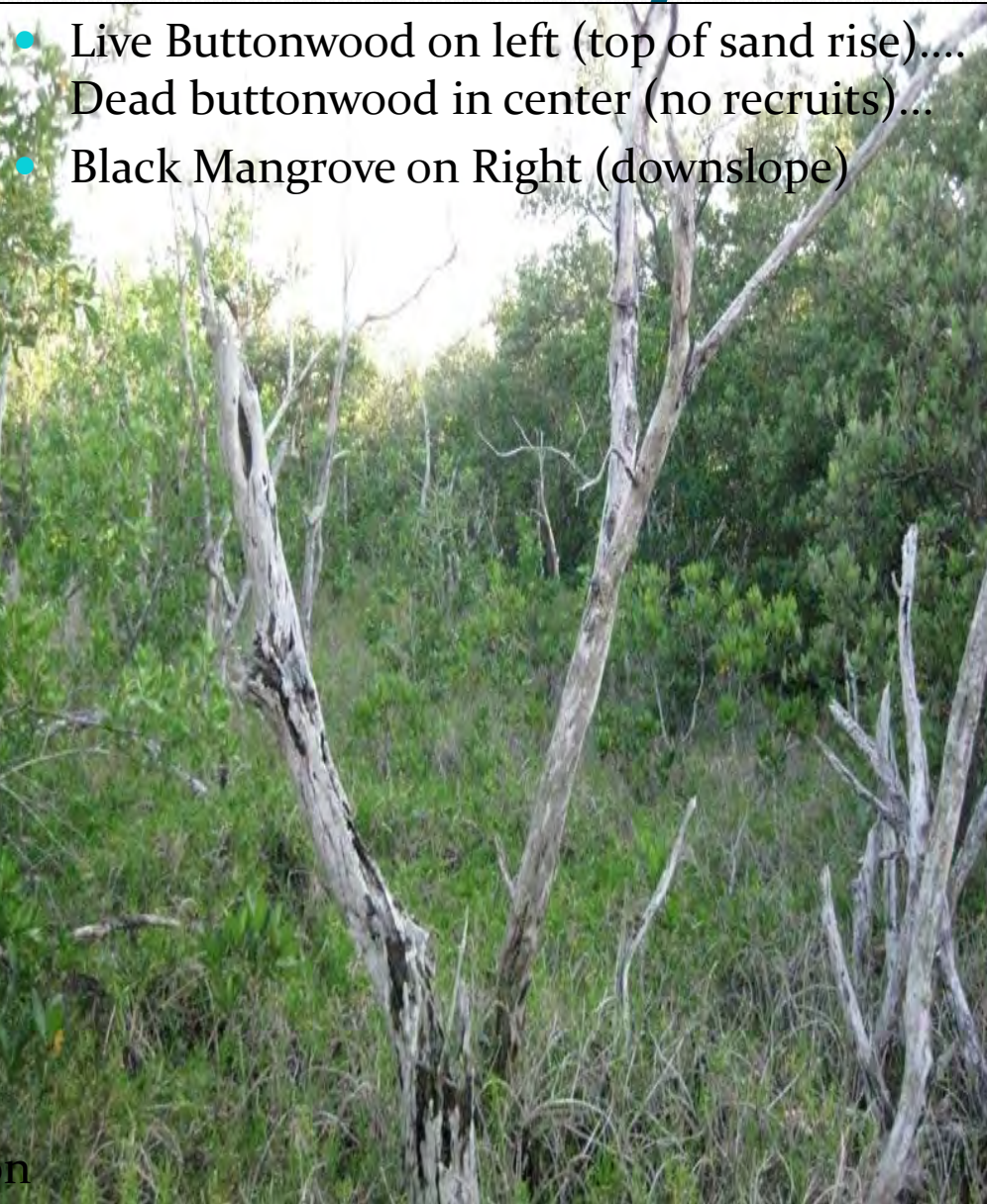
The Big Bend: Coastal Forests Retreat as Sea Levels Rise

- The palms last reproduced in the 1940s in low tidal areas
- Saltmarsh shrubs replacing tree island pine and oak seedlings
- Salinity is the driver here – cabbage palms and red cedar are more salt tolerant
- We can provide
 - Unimpeded opportunities to move uphill



SW FL: Cape Sable – the canary

- **What's going on?**
 - Salt flats are shrinking due to rate of sea level rise
 - Slow deposits being washed out.
 - Hardwoods and cabbage palms die off, replaced by buttonwood
 - Buttonwood replaced by black mangrove



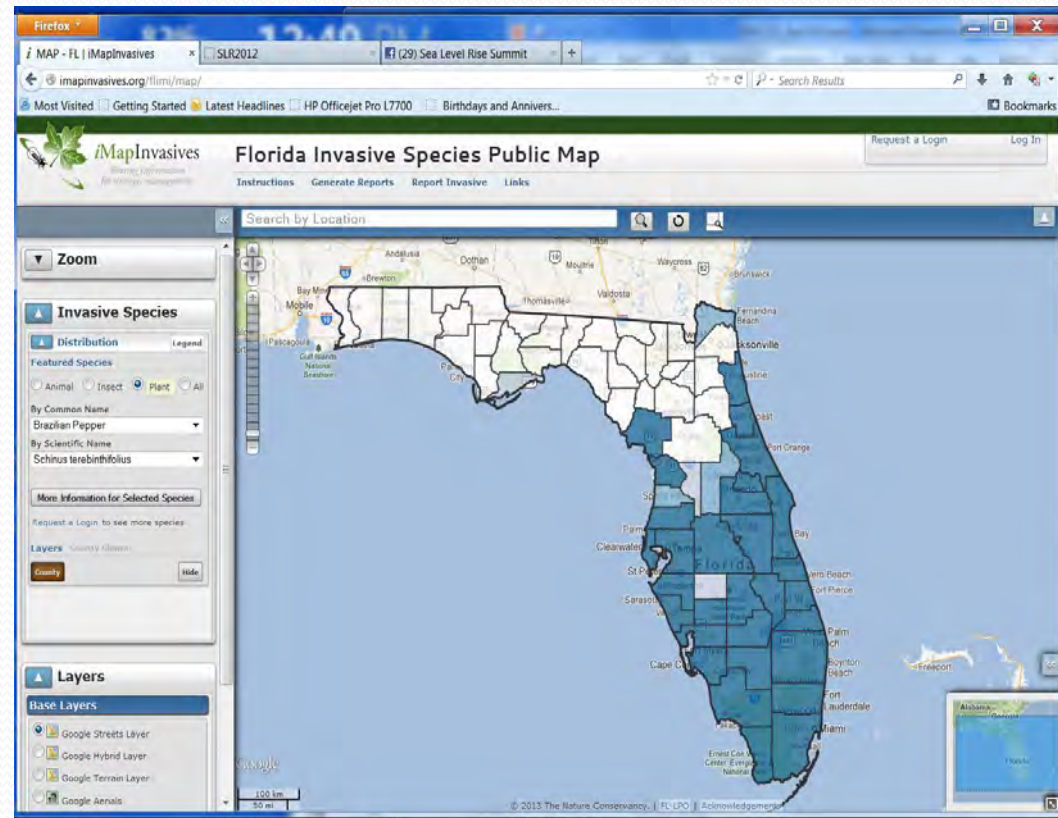
- Live Buttonwood on left (top of sand rise)....
- Dead buttonwood in center (no recruits)...
- Black Mangrove on Right (downslope)

Movin' on Up...

Environmental Stressors and Adaptation

Opportunities – Some things we CAN control

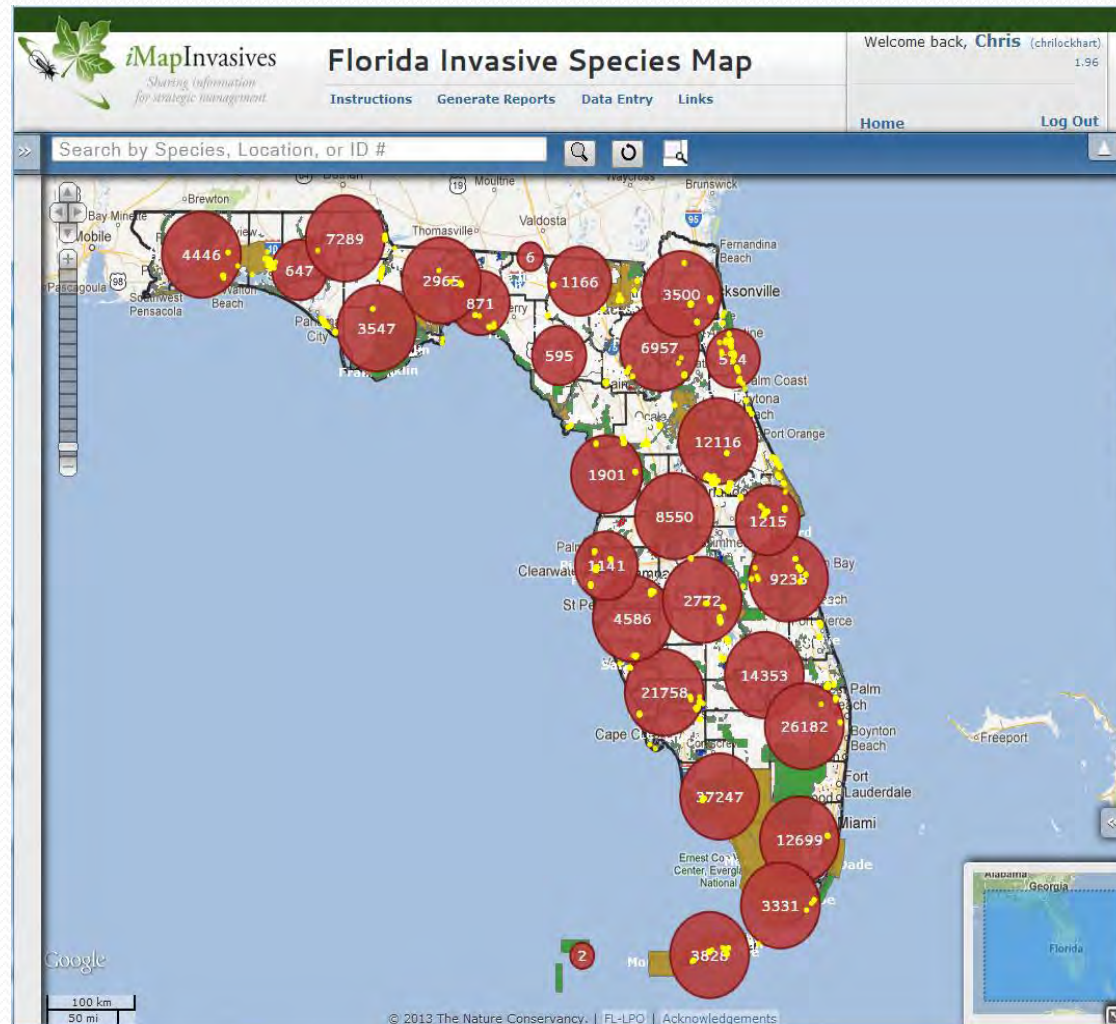
- Invasive Species
 - A major stress
- Adaptation
 - Shifting ranges
 - Naturally or otherwise
 - Brazilian pepper
 - Assisted migration
 - A possible wildlife option
 - Wildlife Corridors
 - Good conservation planning



Distribution of Brazilian pepper, 2010

Invasive Plant Occurrences

- Protecting most vulnerable areas:
 - Big Bend
 - SW FL
 - NE FL
 - Everglades
- Freshwater flow
 - Reduces salinity
 - Allows adaptation



An Erosion Story from H. Sandy





Russian Thistle – *Salsola kali*



A Story from Sandy





A Cool New Plant to Watch?







Who's working on it?

State University System (SUS) White Papers - 2012

- Florida Climate Institute – 6 universities
- FAU's Center For Environmental Studies
- 4 White Papers
 - Climate Scenarios
 - **Biodiversity**
 - Water Management
 - Education
- SFWMD
- USGS
- Oct 2013 – Summit
Fort Lauderdale, FL

FLORIDA CENTER FOR ENVIRONMENTAL STUDIES

Home Program Locations Education Climate Change Conferences

Florida Climate Institute

FAU FLORIDA ATLANTIC UNIVERSITY FLORIDA STATE UNIVERSITY UNIVERSITY OF CENTRAL FLORIDA USF UNIVERSITY OF SOUTH FLORIDA UNIVERSITY OF MIAMI UF UNIVERSITY OF FLORIDA

Florida Climate Institute
The Florida Climate Institute (FCI) is a multi-disciplinary network of national and international research and public organizations, scientists, and individuals concerned with achieving a better understanding of climate variability and change. [Read more...](#)

RISK AND RESPONSE: SEA LEVEL RISE SUMMIT JUNE 20-22, 2012 SLR 2012

Florida Climate Institute FCI

Climate Change Riverwoods DuPuis

Events & Opportunities
[Celebrate Arbor Day 2012](#)

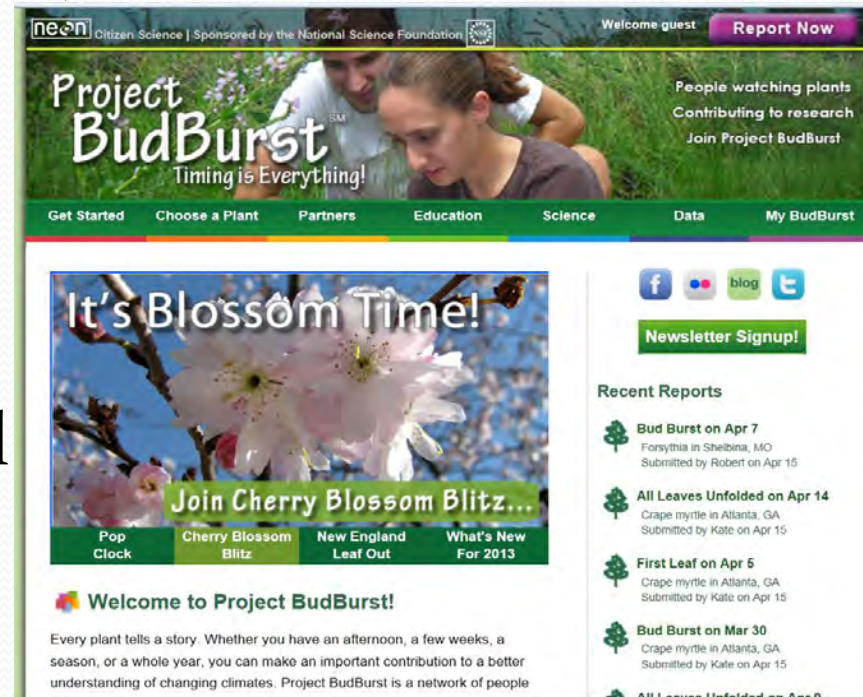
Educational Resources
[Photos of the Month](#)

Make it fun!

- CLEO Institute
- "What is climate change all about, and what's my role?"

www.cleoinsitute.org

- Citizen Science
 - NEON-National Ecological Observatory Network
 - Project BudBurst
 - Budburst.org
 - National Phenology Network



What's next?

- Be a Control freak (on invasives)
- Watch for new problems
- Keep the faith!
- Collect specimens
- Document seasonal changes

Skepticalscience.org
ClimateCentral.org

The screenshot shows a web browser window displaying the Skeptical Science website. The URL is <http://www.skepticalscience.com/2012-climate-review.html>. The page features a navigation menu with links for Home, Arguments, Software, Resources, Comments, The Consensus Project, Translations, About, and Donate. A search bar is located on the left side. The main content area is titled "2012 in Review - a Major Year for Climate Change" and includes a sub-header "Climatic Events of 2012 - Sea Ice Record and Sandy". The article text discusses the significance of 2012 in climate science, mentioning the record-shattering Arctic sea ice melt and Hurricane Sandy. A sidebar on the left lists "MOST USED Climate Myths" with a numbered list: 1. Climate's changed before, 2. It's the sun, 3. It's not bad, 4. There is no consensus, 5. It's cooling, 6. Models are unreliable. A "Look up a Term" button is at the bottom of the sidebar. On the right side, there are promotional banners for "The Consensus Project Website" and "Winner of the 2011 Australian museum Eureka Prize Advancement of".

Acknowledgements

- Mike Barry, IRC
- Francis “Jack” Putz, University of Florida
- FAU Center for Environmental Studies
- FL Natural Areas Inventory
- Jim Cuda, UF
- John Englander
- Capt. Dan Kipnis
- Caroline Lewis, CLEO Institute
- Brian Soden, University of Miami

Taking Action...

- Southeast Florida Regional Climate Change Task Force: Monroe, Miami-Dade, Broward, Palm Beach Counties
 - AKA: 4 County Compact, may be 6
 - Working together for common solutions



**Drainage canals for development
create avenues for salt water to
travel further inland**

M. Barry, Institute for Regional Conservation