



USGS coastal wetland surface elevation change studies in the Greater Everglades

Michael J. Osland

U.S. Geological Survey, Wetland and Aquatic Research Center
Lafayette, Louisiana

Support



Greater Everglades Priority
Ecosystem Science (PES) Program

Tom Smith



Kevin Whelan



Gordon Anderson



Karen Balentine



Paul Nelson



Ginger Range

Ches
Vervaeke

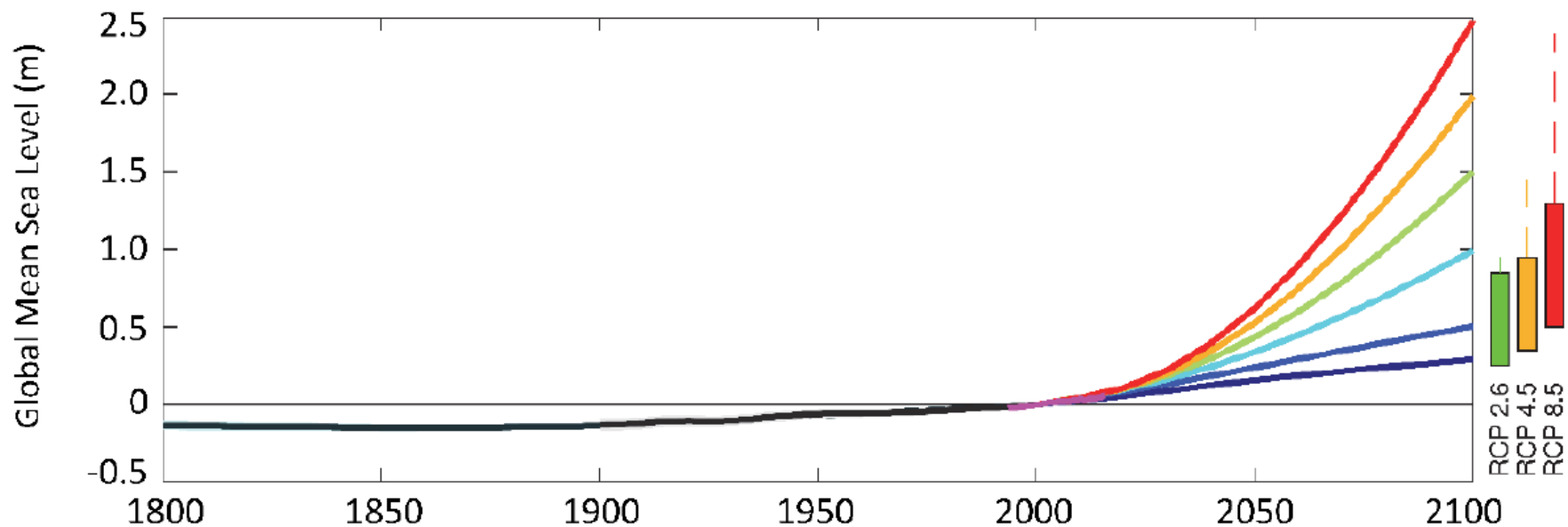
Laura
Feher



Ken
Krauss

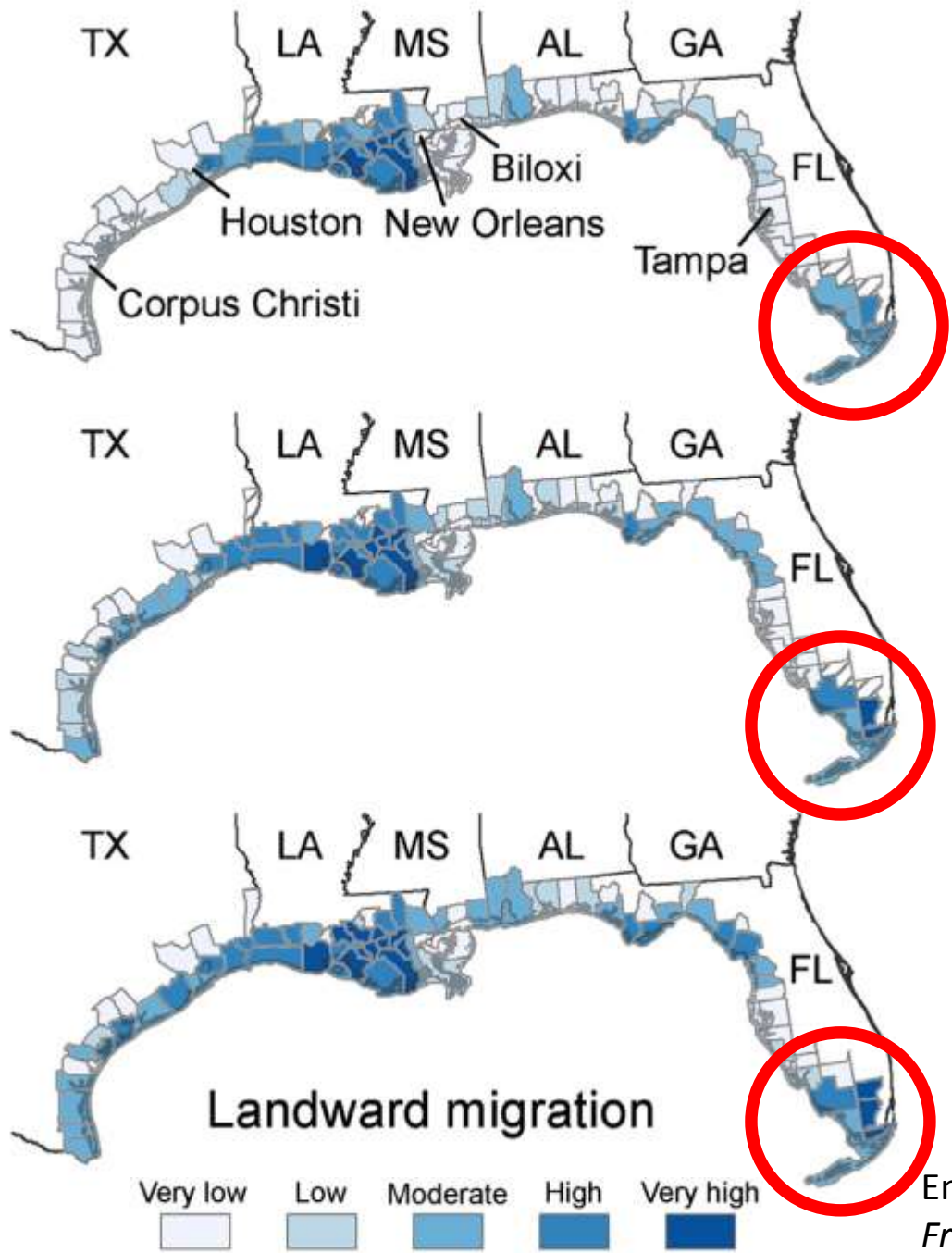


NOAA Global Mean Sea Level (GMSL) Scenarios for 2100



Scenario	SLR by 2100 (m)
Low	0.3
Intermediate-Low	0.5
Intermediate	1.0
Intermediate-High	1.5
High	2.0
Extreme	2.5

0.5 m sea-level rise
1.2 m sea-level rise
2.0 m sea-level rise

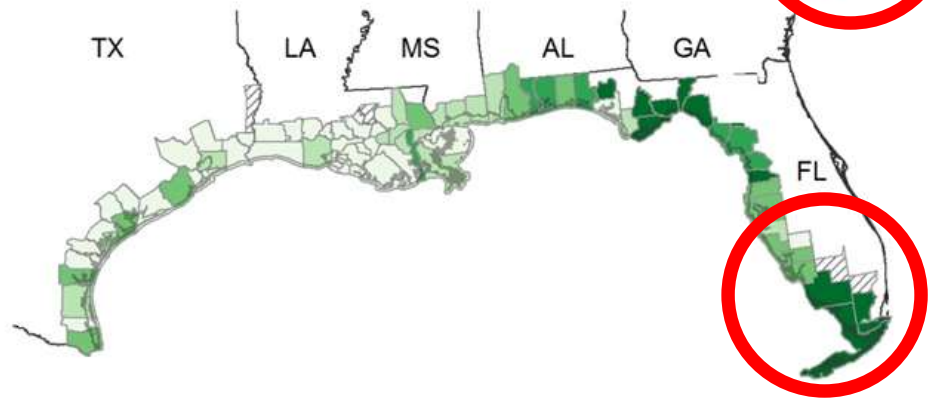


Landward migration of wetlands in response to sea-level rise

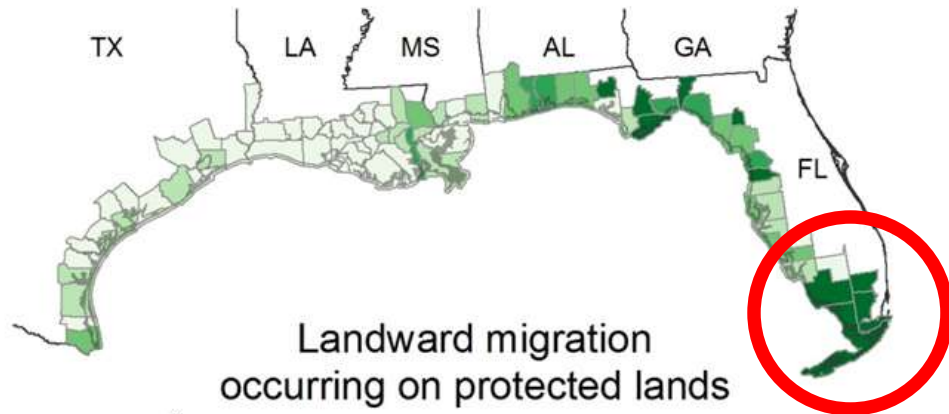
0.5 m sea-level rise



1.2 m sea-level rise



2.0 m sea-level rise

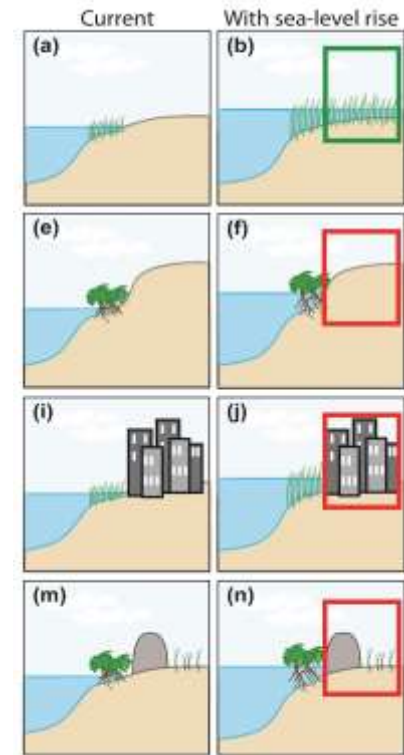
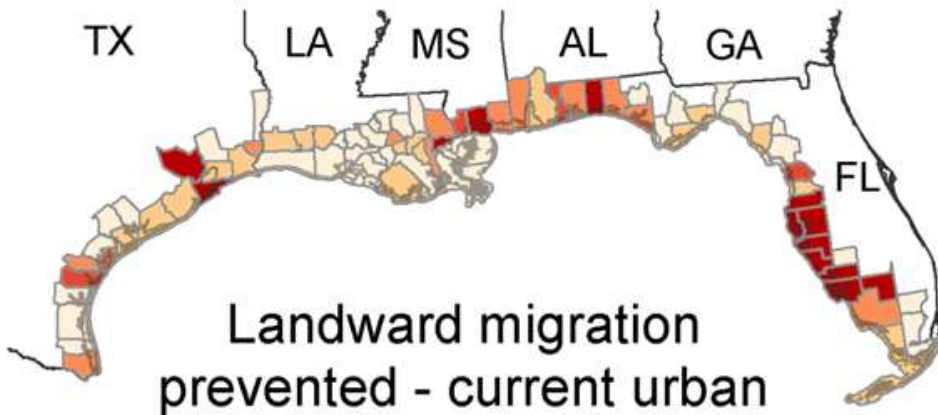
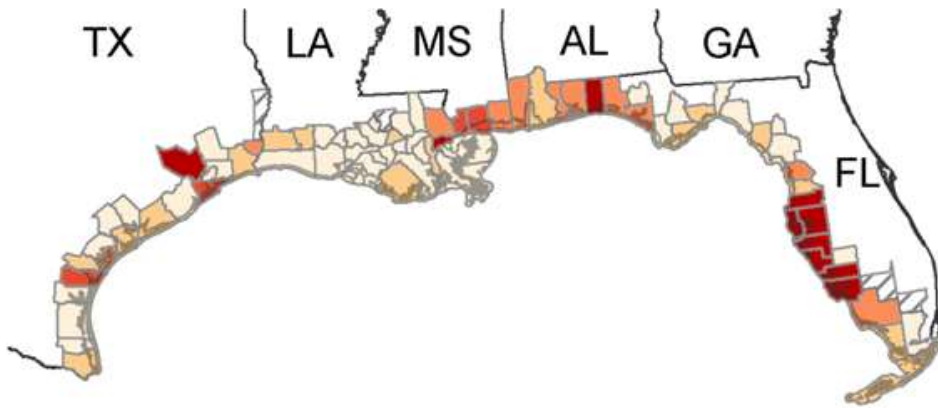
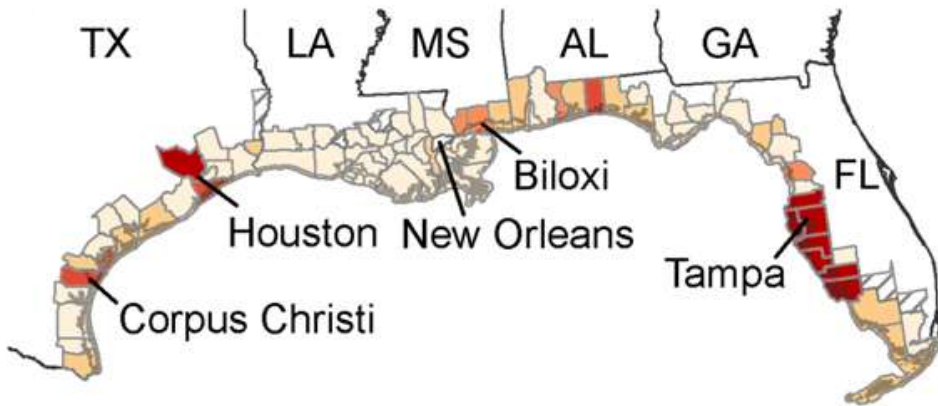


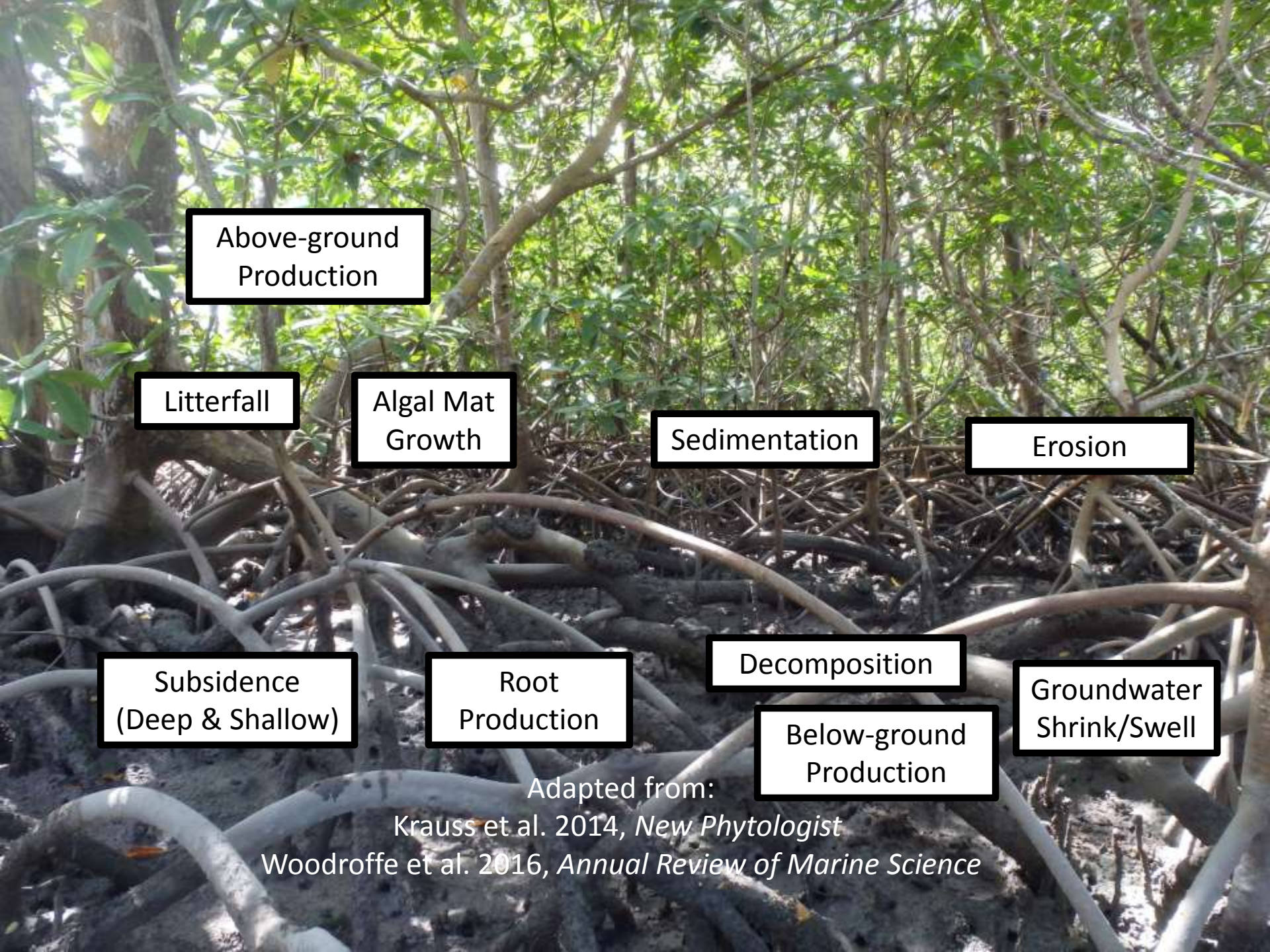
Landward migration occurring on protected lands



Landward migration of wetlands on protected lands

Urban barriers to landward migration of wetlands





Above-ground
Production

Litterfall

Algal Mat
Growth

Sedimentation

Erosion

Subsidence
(Deep & Shallow)

Root
Production

Decomposition

Below-ground
Production

Groundwater
Shrink/Swell

Adapted from:
Krauss et al. 2014, *New Phytologist*
Woodroffe et al. 2016, *Annual Review of Marine Science*

Surface Elevation Table- Marker Horizon (SET-MH) Approach

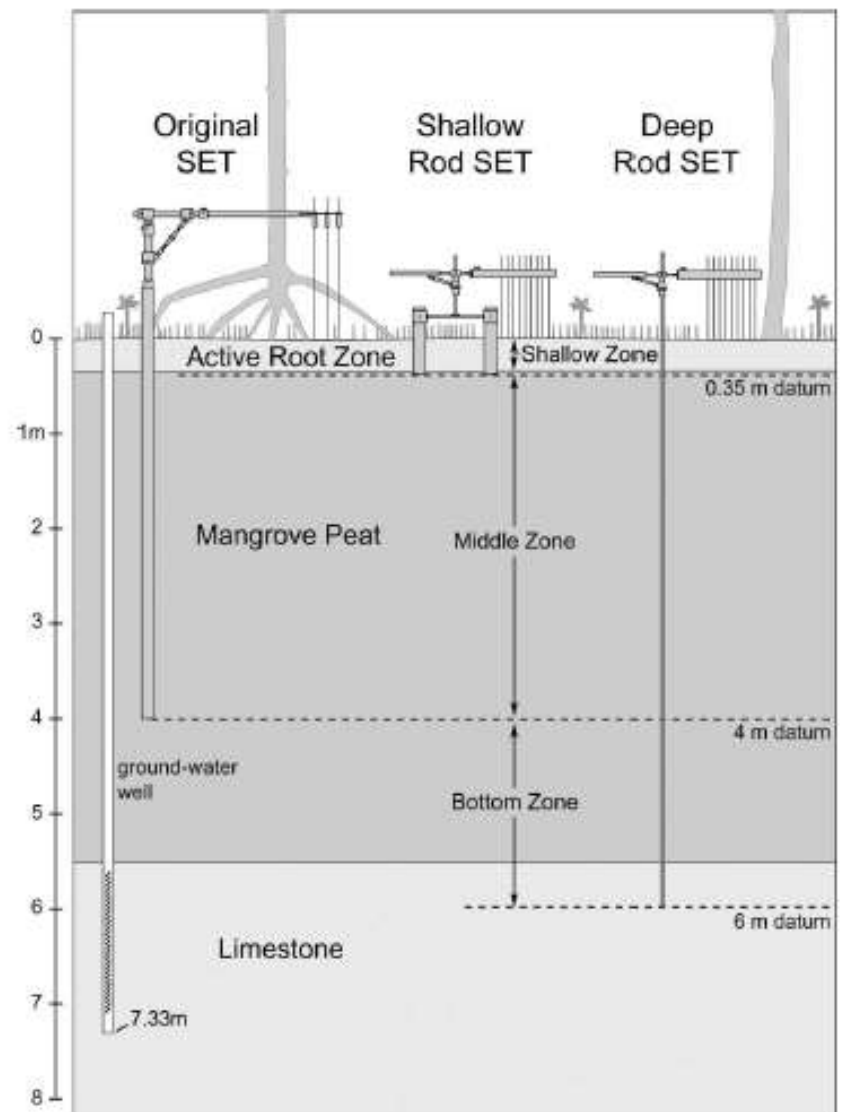


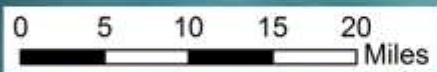
Figure 1. Illustration (1:24 scale) of a Shark River soil profile showing accretion, shallow, middle, and bottom soil zones, and placement depths of Original SETs, Deep, and Shallow-RSETs and a groundwater well (adapted from Whelan et al. 2005, with permission).

Figure from Whelan et al. 2009, *Wetlands*

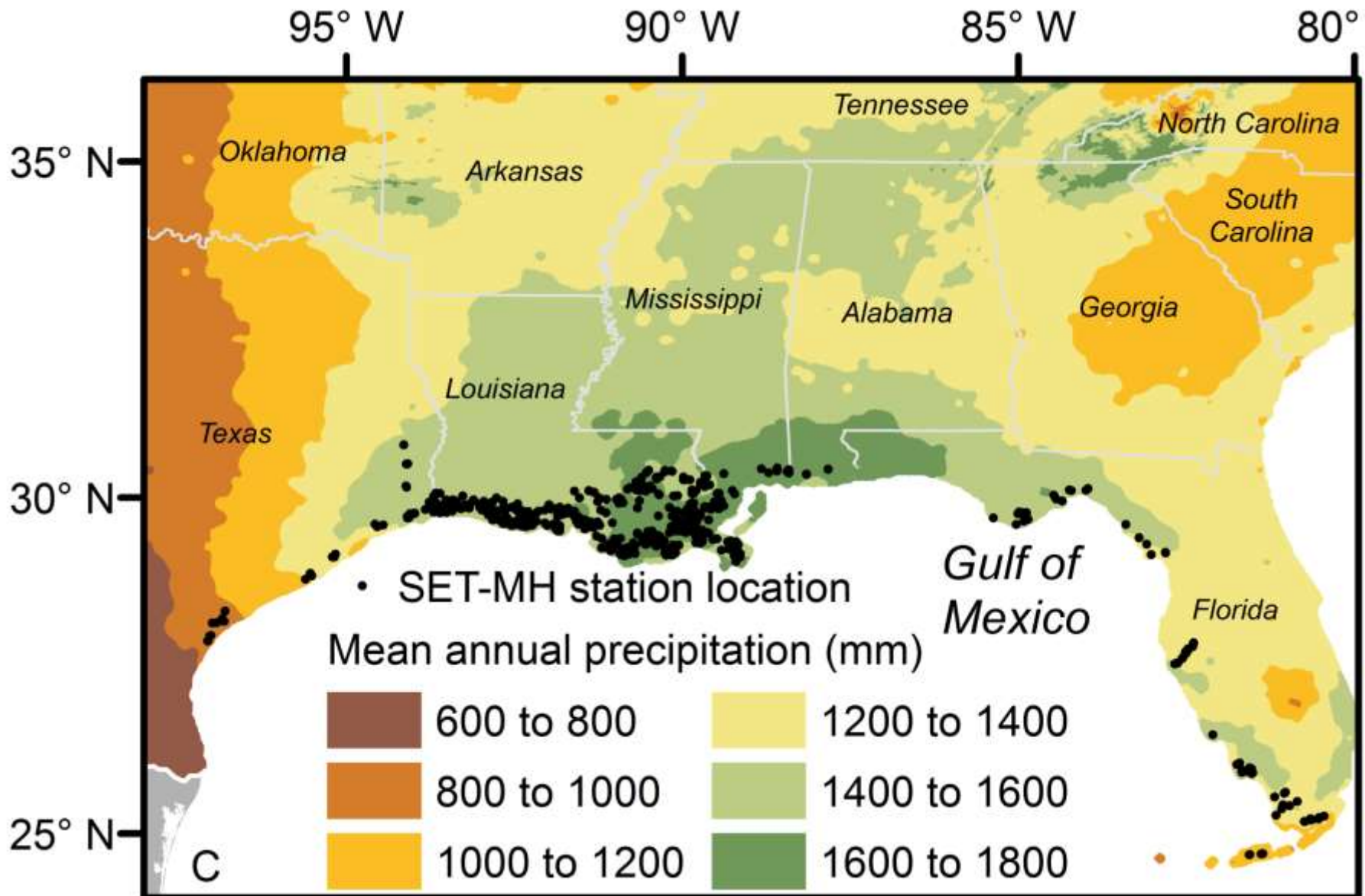
63 SETs
24 original SET
15 deep RSET
24 shallow RSET

First installations
in 1998

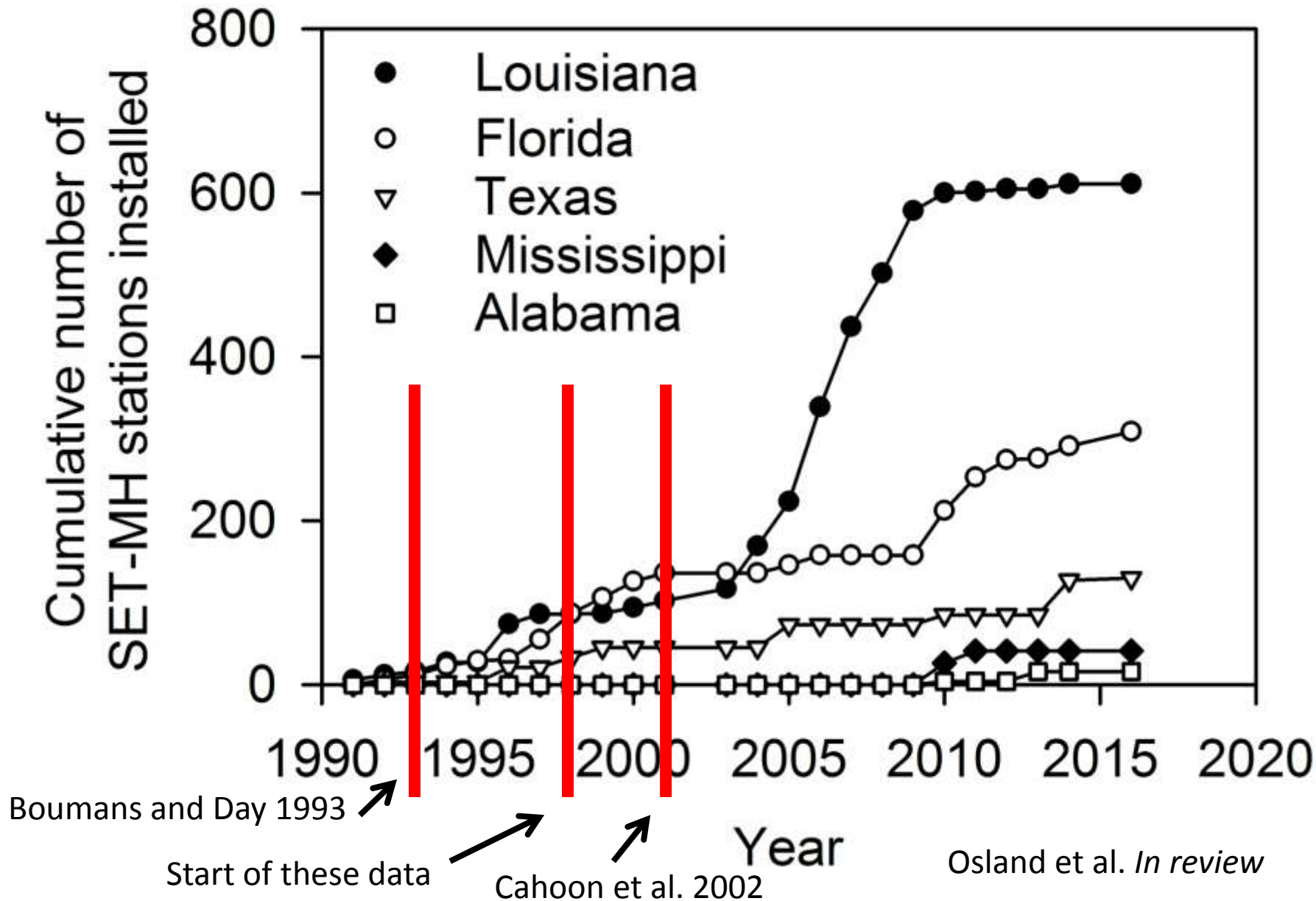
- SET-MH sites
- Everglades NP



SET-MH Stations in the northern Gulf of Mexico



Temporal installation of SET-MH Stations in the northern Gulf of Mexico



ORIGINAL

NO. 44
NO. 45
NO. 46



Date: 20/08/2019
 Shop Name: S.S.S. Puri
 Title: Stressing - steel structure
 Drawn by: S. Prakash
 Read by: M. S. Jagan
 Fabricator measured by: M. S. Jagan
 Order used: 1000/2019

Read from TOP of plate

O-1	115	150	200	240	Falderpar mm	1	2	3
1	115	150	200	240	0			
2	115	150	200	240	0			
3	115	150	200	240	0			
4	115	150	200	240	0			
5	115	150	200	240	0			
6	115	150	200	240	0			
7	115	150	200	240	0			
8	115	150	200	240	0			
9	115	150	200	240	0			
H.O	115	150	200	240	0			



0-2 to 0-3 (0-1)

O-2	20	60	100	140	Falderpar mm	1	2	3
1	20	60	100	140	0			
2	20	60	100	140	0			
3	20	60	100	140	0			
4	20	60	100	140	0			
5	20	60	100	140	0			
6	20	60	100	140	0			
7	20	60	100	140	0			
8	20	60	100	140	0			
9	20	60	100	140	0			
H.O	20	60	100	140	0			



0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

0-2 to 0-3 (0-1)

O-3	220	260	300	350	Falderpar mm	1	2	3
1	220	260	300	350	0			
2	220	260	300	350	0			
3	220	260	300	350	0			
4	220	260	300	350	0			
5	220	260	300	350	0			
6	220	260	300	350	0			
7	220	260	300	350	0			
8	220	260	300	350	0			
9	220	260	300	350	0			
H.O	220	260	300	350	0			



Data under review and will be made available as a USGS Data Release on Sciencebase.gov

The screenshot shows the USGS ScienceBase Catalog homepage. At the top, there is a navigation bar with the USGS logo and the tagline "science for a changing world". Below the navigation bar, there is a search bar with the placeholder text "Type some text to search..." and a "Search" button. To the right of the search bar is a link for "Advanced Search".

Below the search bar, there are four main content blocks:

- I want to:** A list of links including "Login", "Add Data", "Access Help", and "Report a Problem".
- Browse by Category:** A list of categories including "Map", "Data", "Physical Item", "Project", "Publication", "Web Site", and "USGS Data Release".
- Browse by Tag:** A list of tags including "Animal Behaviour", "Biogeochemistry", "Ecosystems", "Hazard Mitigation", "Hydrology", and "All tags...".
- Browse by Location:** A map of the United States.

Below these blocks, there is a section titled "View USGS data releases in ScienceBase" with the subtitle "Instructions for completing a data release in ScienceBase".

Below that, there is a "Featured Item" section. The featured item is titled "Pharmaceutical contaminant concentration and watershed geospatial land-use/land-cover data for small Wadeable streams in the Piedmont ecoregion of the USA assessed during the Southeastern Region Stream Quality Assessment during April through June 2014". The description states: "Filtered water samples were collected by the USGS National Water Quality Program (NWQP) Southeastern Stream Quality Assessment (SESQA) from 59 perennial, Wadeable (less than 10 m width and 1 m depth at base-flow) headwater stream sites in watersheds with varying degrees of urban land use in four states. Dataset includes sample site locations and information, analytical method information, water sample pharmaceutical concentrations and summary statistics, and corresponding watershed land-use/land-cover data and data dictionary." The categories listed are "Data", "Type: Dataset", "Map Service", "OGC WFS Layer", "OGC WMS Layer", "OGC WMS Service", and the tags are "Georgia", "North America", "North Carolina", "South Carolina", "USGS Science Data Catalog (SDC)", and "All tags...".

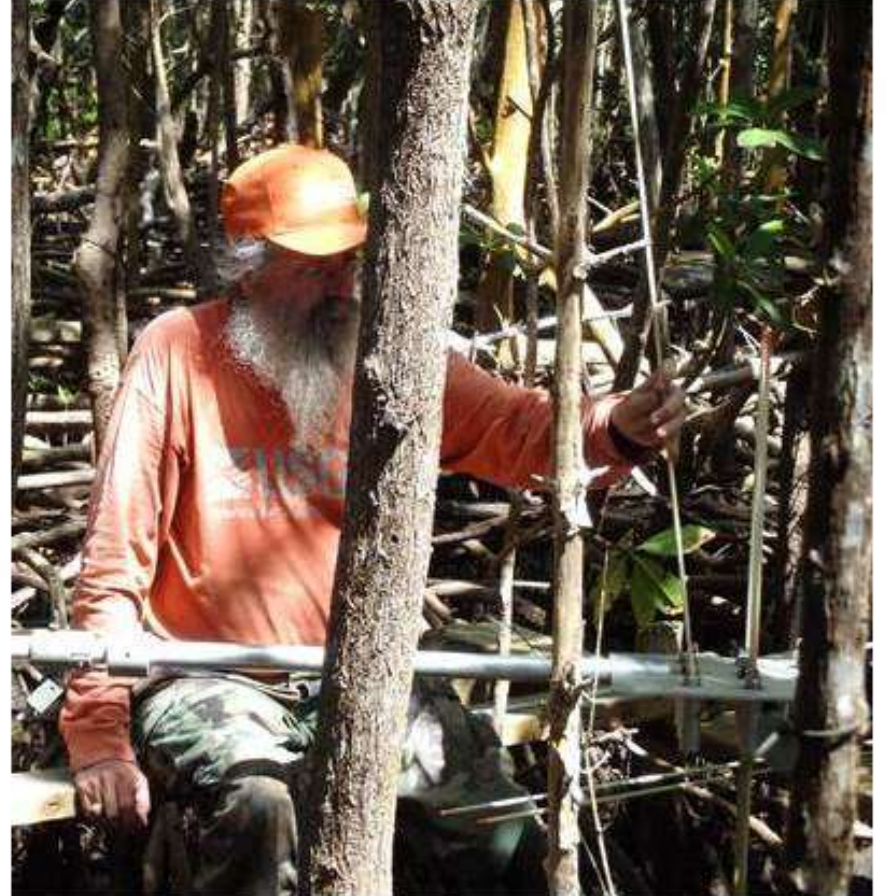
At the bottom of the page, there is a footer with links for "Accessibility", "FOIA", "Privacy", and "Policies and Notices". The footer also includes the text "U.S. Department of the Interior | U.S. Geological Survey" and the USGS logo.



SETs over time..



2002



2014















Groundwater Control of Mangrove Surface Elevation: Shrink and Swell Varies with Soil Depth

KEVIN R. T. WHELAN^{1,*}, THOMAS J. SMITH III², DONALD R. CAHOON³, JAMES C. LYNCH³, and GORDON H. ANDERSON⁴

¹ *U.S. Geological Survey, Florida Integrated Science Center, c/o Florida International University, Department of Biological Sciences, Owa Ehan, 167, University Park, 11200 SW 8 Street, Miami, Florida 33199*

² *U.S. Geological Survey, Florida Integrated Science Center, 600 Fourth Street South, St. Petersburg, Florida 33701*

³ *U.S. Geological Survey, Patuxent Wildlife Research Center, 10300 Baltimore Avenue, BARC-EAST Building #308, Beltsville, Maryland 20705*

⁴ *U.S. Geological Survey, Florida Integrated Science Center, c/o Everglades National Park Field Station, 40001 State Road 9336, Homestead, Florida 33034*

Questions

- What is the influence of hydrologic variability on soil elevation?
- What are the relative contributions of four components of the soil profile:
 - Surface
 - Shallow (0-0.35 m)
 - Middle (0.35-4 m)
 - Bottom (4-6 m)

From: Whelan et al. 2005 *Estuaries*

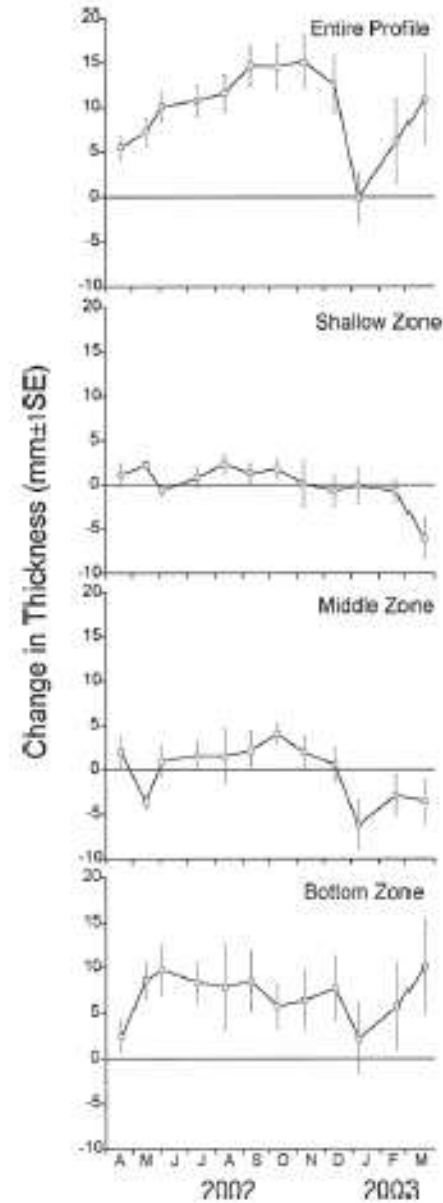
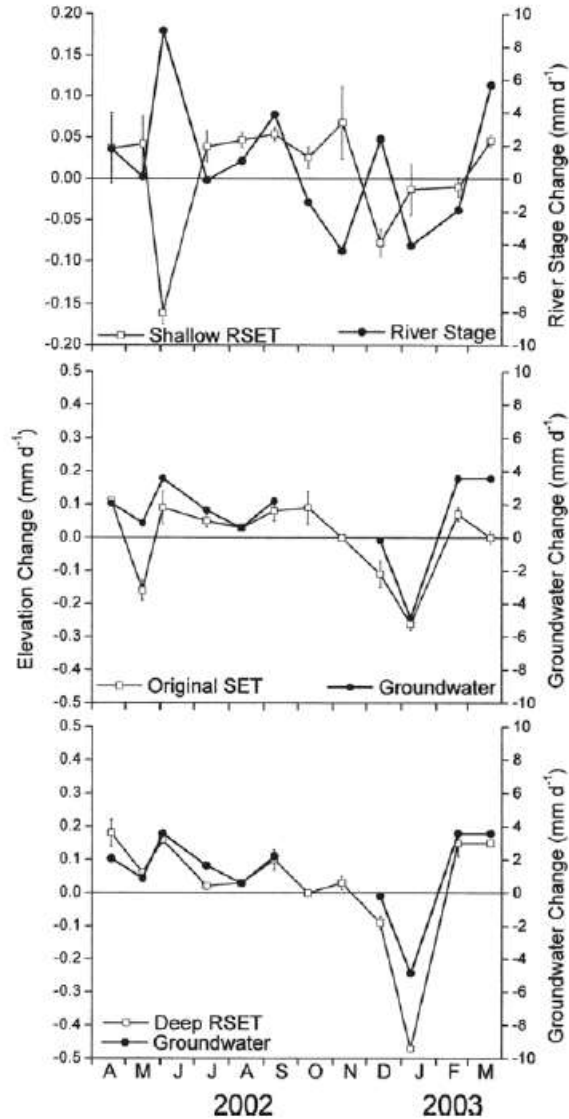


Fig. 4. Mean (± 1 SD) rate of change for the three shallow-RSETs and the rate of change in river stage, three original-SETs and rate of change in groundwater piezometric head, and three deep-RSETs and rate of change in groundwater piezometric head.

CUMULATIVE IMPACTS OF HURRICANES ON FLORIDA MANGROVE ECOSYSTEMS: SEDIMENT DEPOSITION, STORM SURGES AND VEGETATION

Thomas J. Smith III¹, Gordon H. Anderson², Karen Balentine², Ginger Tiling³, Greg A. Ward⁴, and
Kevin R. T. Whelan⁵

¹*U.S. Geological Survey, Florida Integrated Science Center, 600 Fourth Street South, Saint Petersburg, Florida, USA 33701. E-mail: Tom_J_Smith@usgs.gov*

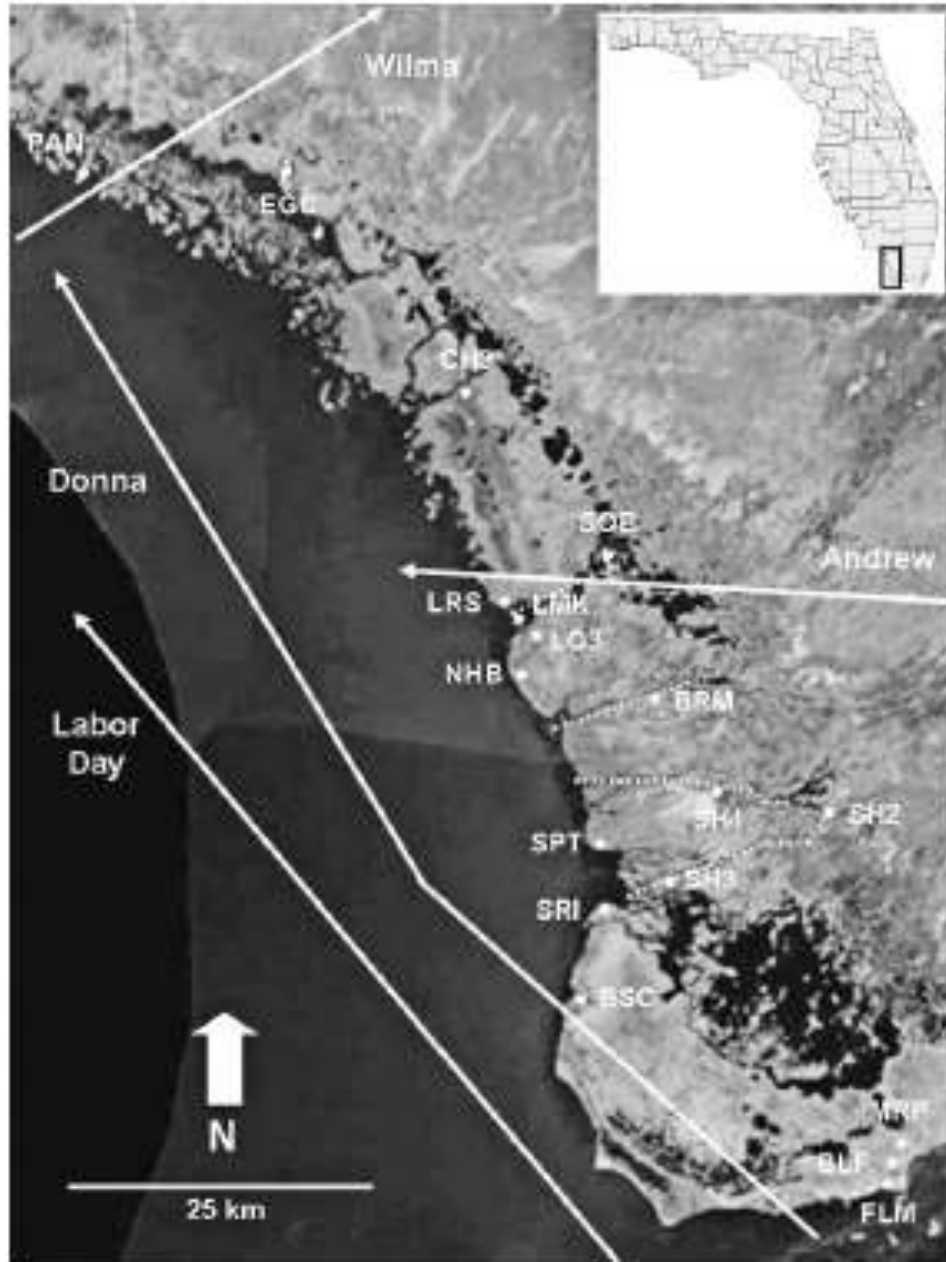
²*U.S. Geological Survey, Florida Integrated Science Center, Everglades Field Station, 40001 SR 9336, Homestead, Florida, USA 33034*

³*Jacobs Technology, Inc., c/o 600 Fourth Street South, Saint Petersburg, Florida, USA 33701*

⁴*Coastal Planning & Engineering, Inc., 2481 Boca Raton Blvd., Boca Raton, Florida, USA 33431*

⁵*U.S. National Park Service, South Florida – Caribbean Inventory and Monitoring Network, 18001 Old Cutler Road, Suite 419, Palmetto Bay, Florida, USA 33157*

From: Smith et al. 2009 *Wetlands*



From: Smith et al. 2009 *Wetlands*

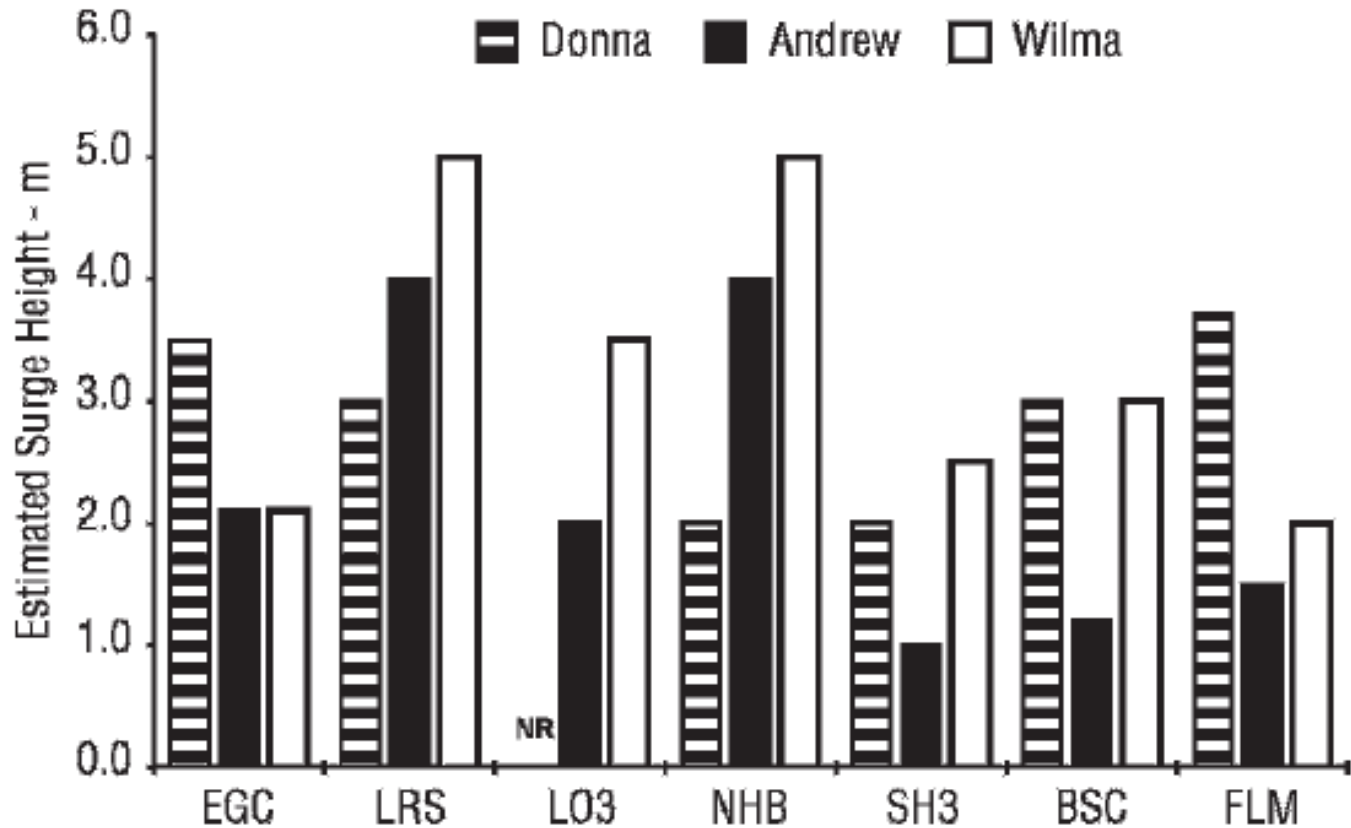


Figure 5. Estimated storm surge heights from Hurricanes Donna, Andrew and Wilma for seven locations along a north to south transect on the southwest Florida coastline. NR = Not reported.

From: Smith et al. 2009 *Wetlands*

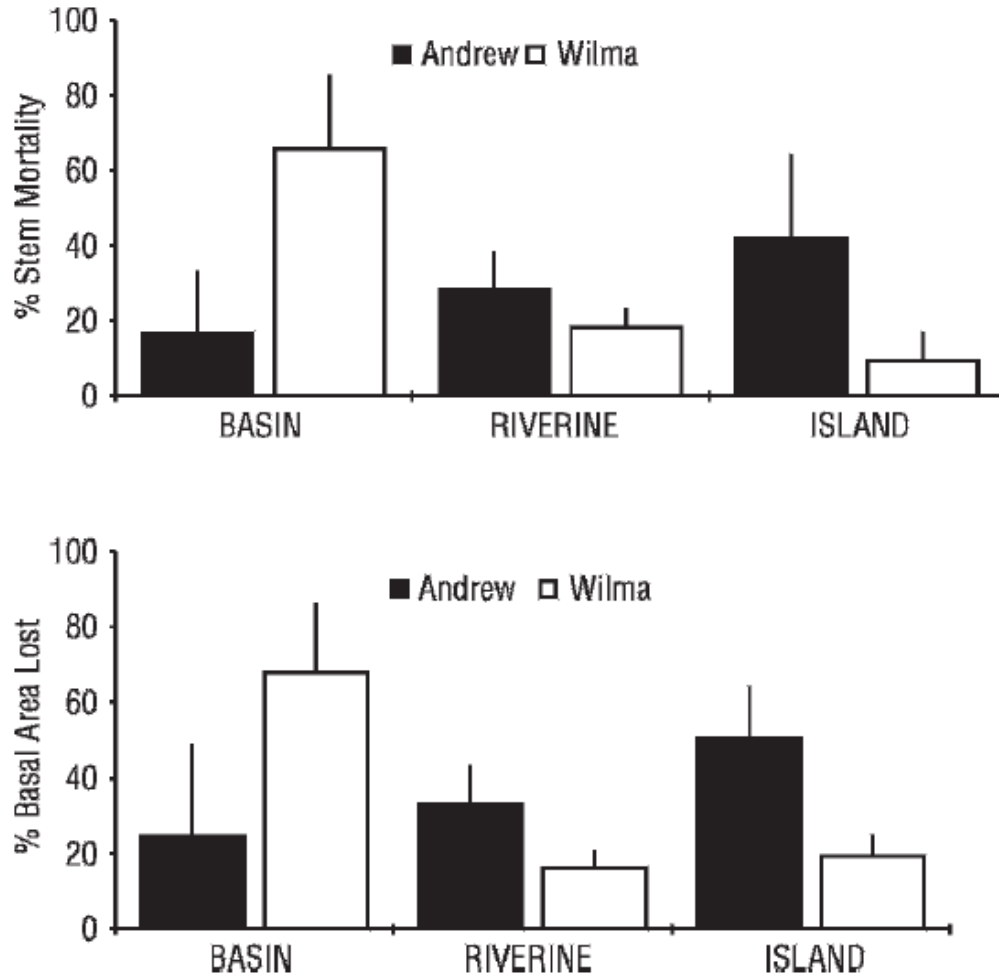
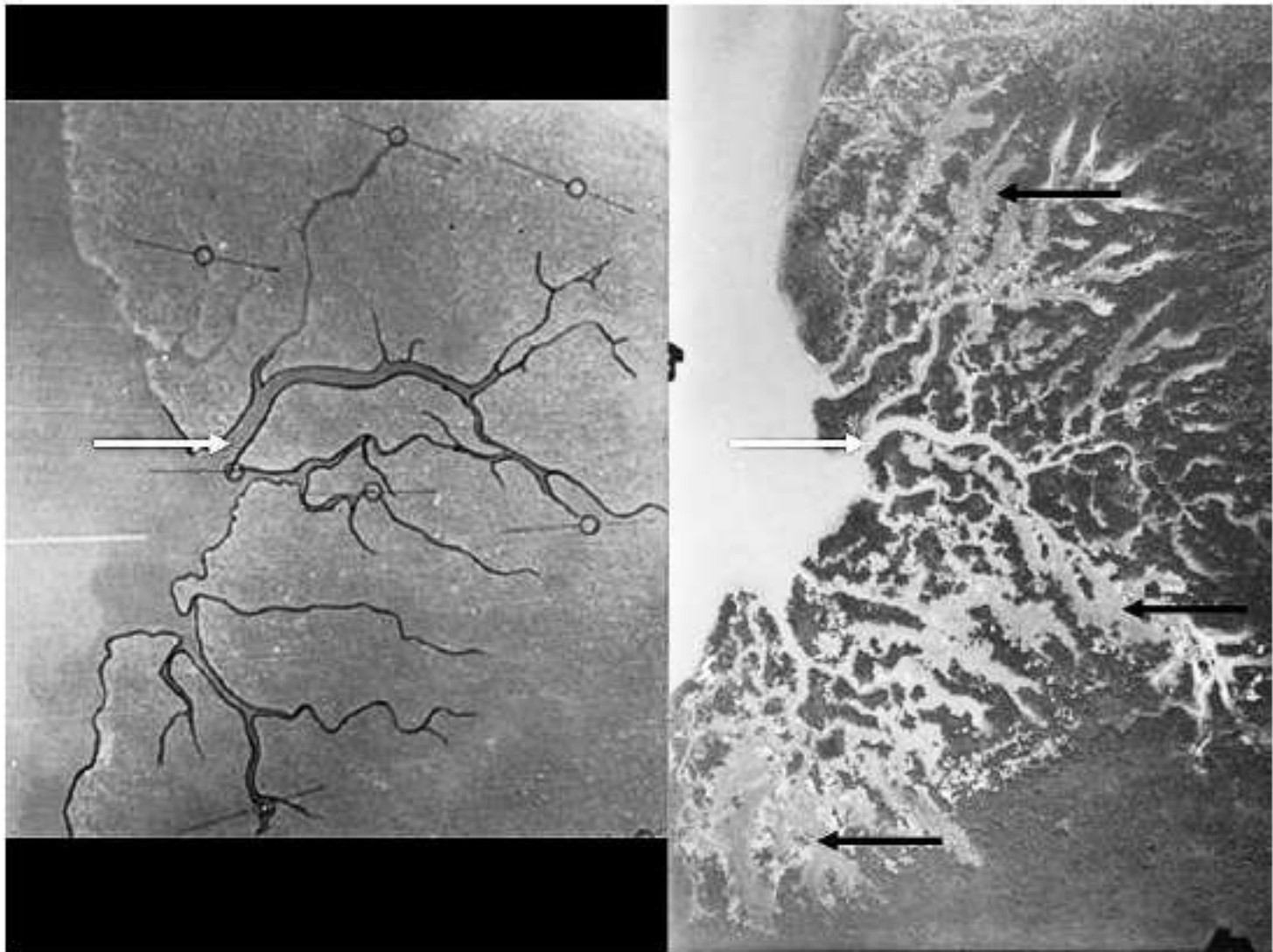


Figure 8. Graphic representation of the Forest Type by Hurricane interaction for % stem mortality (upper) and % basal area lost (lower). The data have been averaged over the three species of mangrove. Values are $\bar{X} \pm 1SE$.

From: Smith et al. 2009 *Wetlands*



From: Smith et al. 2009 *Wetlands*

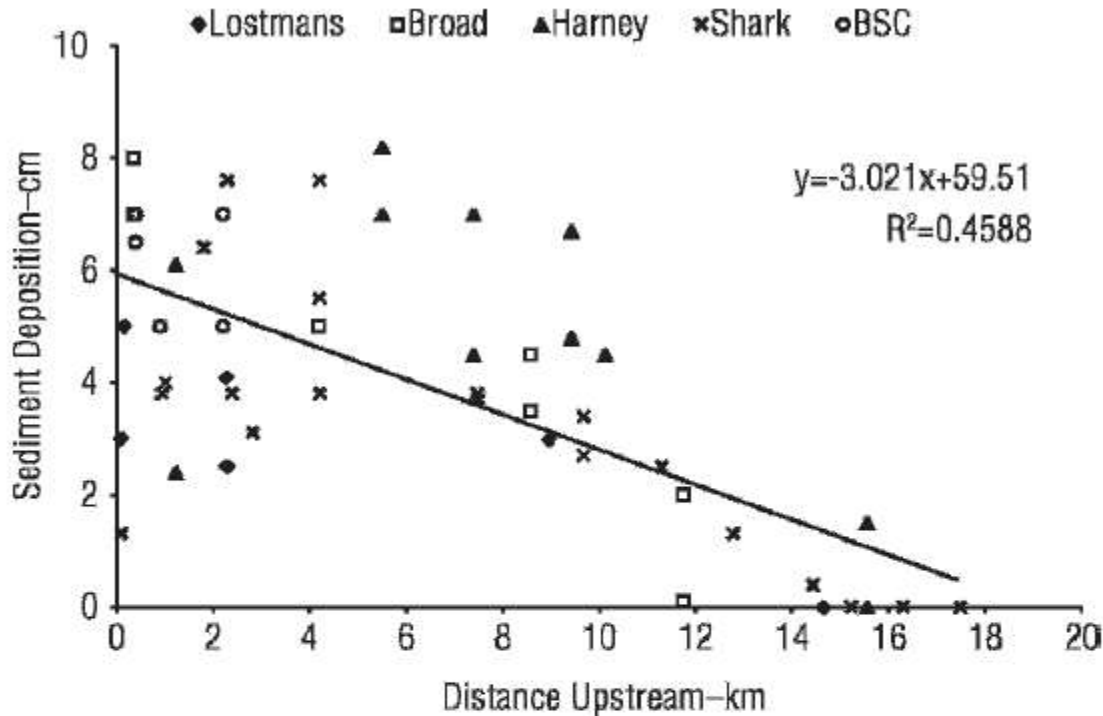


Figure 6. Sediment deposition (cm) from Hurricane Wilma as a function of distance upstream from the Gulf of Mexico (km) for five tidal rivers and creeks in Everglades National Park. There were no differences between rivers so a single regression line is given. Key for symbols: Lostmans (◆), Broad (□), Harney (▲), Shark (X) and Big Sable Creek (O).

WETLANDS, Vol. 29, No. 1, March 2009, pp. 16–23
© 2009, The Society of Wetland Scientists

HURRICANE WILMA'S IMPACT ON OVERALL SOIL ELEVATION AND ZONES WITHIN THE SOIL PROFILE IN A MANGROVE FOREST

Kevin R. T. Whelan¹, Thomas J. Smith III², Gordon H. Anderson³, and Michelle L. Ouellette⁴

¹*National Park Service, South Florida Caribbean Inventory and Monitoring Network, 18001 Old Cutler Road Suite 419, Miami, Florida, USA 33157. E-mail: Kevin_R_Whelan@nps.gov*

²*U.S. Geological Survey, Florida Integrated Science Center, Center for Coastal and Watershed Studies, 600 Fourth Street, South, St. Petersburg, Florida, USA 33701*

³*U.S. Geological Survey, Florida Integrated Science Center, Everglades National Park Field Station, 40001 State Rd 9336, Homestead, Florida, USA 33034*

⁴*Florida International University, Environmental Science Research Internship, Environmental Studies Department, 11200 SW 8 Street, Miami, Florida, USA 33199*

Questions

- What is the affect of storm deposits from Hurricane Wilma on surface elevation and subsurface soil processes?
- What are the relative contributions of four components of the soil profile:
 - Surface
 - Shallow (0-0.35 m)
 - Middle (0.35-4 m)
 - Bottom (4-6 m)

From: Whelan et al. 2009 *Wetlands*

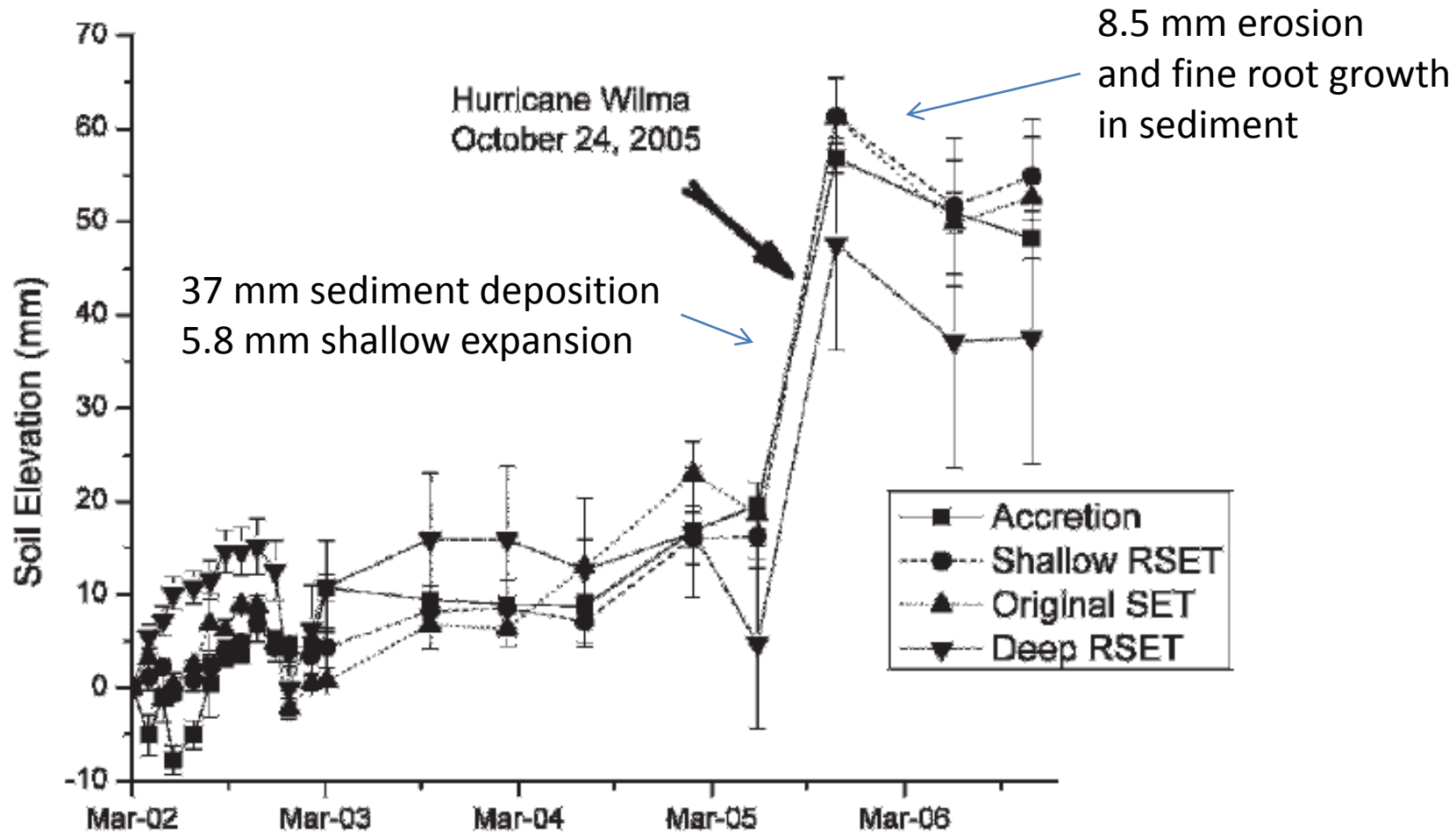


Figure 2. Long term mean (± 1 SD) absolute soil surface elevations for Accretion, Shallow-RSET, Original-SET, and Deep-RSET at a mangrove forest on the Shark River capturing the impact of Hurricane Wilma.

From: Whelan et al. 2009 *Wetlands*

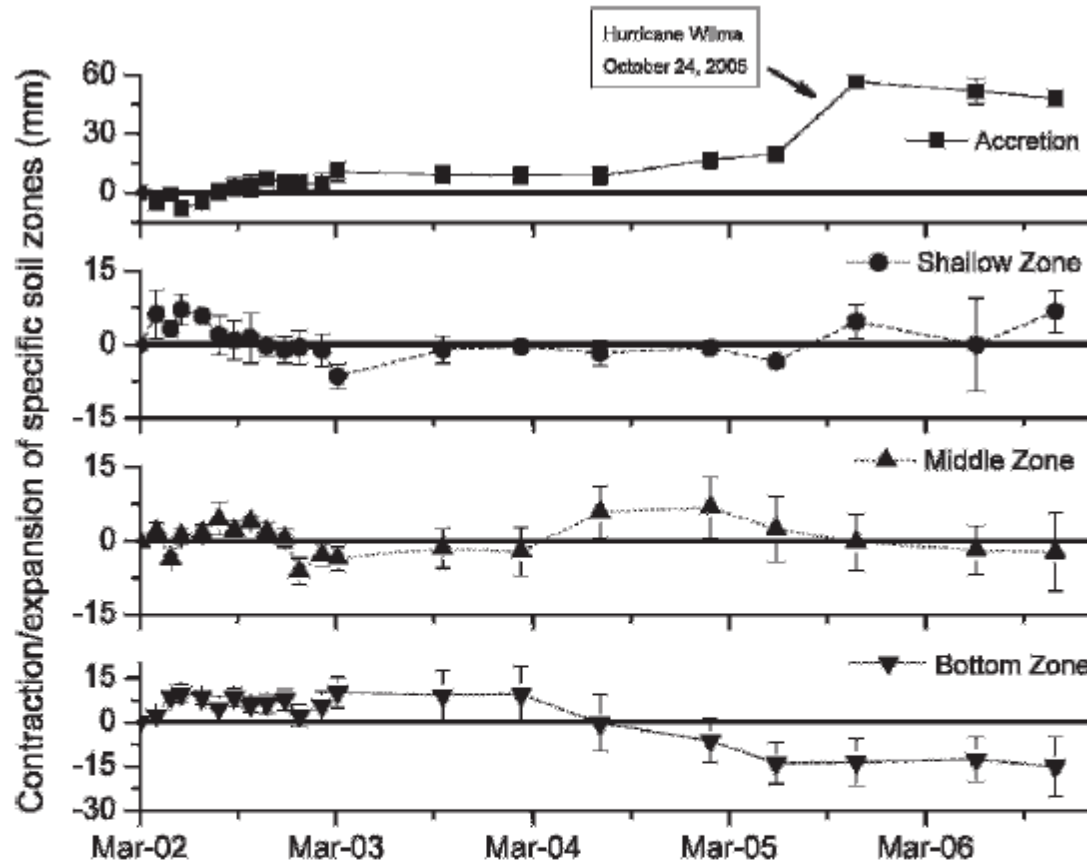


Figure 3. Absolute mean (± 1 SD) contraction/expansion of the four constituent soil zones: accretion zone, shallow zone, middle zone, and bottom zone relative to the contraction/expansion of the entire soil profile as measured by the Deep RSET (calculations are based on Equation 2, Whelan et al. 2005).

Data are under review and will be made available as a USGS Data Release on Sciencebase.gov

The screenshot shows the USGS ScienceBase Catalog homepage. At the top, there is a navigation bar with the USGS logo and the tagline "science for a changing world". Below the navigation bar, there is a search bar with the placeholder text "Type some text to search..." and a "Search" button. To the right of the search bar is a link for "Advanced Search".

Below the search bar, there are four main content blocks:

- I want to:** A list of links including "Login", "Add Data", "Access Help", and "Report a Problem".
- Browse by Category:** A list of categories including "Map", "Data", "Physical Item", "Project", "Publication", "Web Site", and "USGS Data Release".
- Browse by Tag:** A list of tags including "Animal Behaviour", "Biogeochemistry", "Ecosystems", "Hazard Mitigation", "Hydrology", and "All tags...".
- Browse by Location:** A map of the United States.

Below these four blocks, there is a section titled "View USGS data releases in ScienceBase" with the subtitle "Instructions for completing a data release in ScienceBase".

Below that, there is a "Featured Item" section. The featured item is titled "Pharmaceutical contaminant concentration and watershed geospatial land-use/land-cover data for small Wadeable streams in the Piedmont ecoregion of the USA assessed during the Southeastern Region Stream Quality Assessment during April through June 2014". The description states: "Filtered water samples were collected by the USGS National Water Quality Program (NWQP) Southeastern Stream Quality Assessment (SESQA) from 59 perennial, Wadeable (less than 10 m width and 1 m depth at base-flow) headwater stream sites in watersheds with varying degrees of urban land use in four states. Dataset includes sample site locations and information, analytical method information, water sample pharmaceutical concentrations and summary statistics, and corresponding watershed land-use/land-cover data and data dictionary." The categories listed are "Data", "Type: Dataset", "Map Service", "OGC WFS Layer", "OGC WMS Layer", "OGC WMS Service", and "Tags: Georgia, North America, North Carolina, South Carolina, USGS Science Data Catalog (SDC)". There is also a link for "All tags...".

At the bottom of the page, there is a footer with links for "Accessibility", "FOIA", "Privacy", and "Policies and Notices". The footer also includes the text "U.S. Department of the Interior | U.S. Geological Survey" and the USGS logo.

