



Hurricanes as resilience builders

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HURRICANE IRMA CROSSES FLORIDA ON 10 SEPTEMBER 2017

EL VERDE FIELD STATION AFTER H. MARIA 4 OCT 2017











Sea Level



Resilience: A system's ability to cope, adapt, or transform to sustain form, function, and identity in response to disturbance

 In coastal zones, the ability to maintain <u>elevation</u> in the face of sea level rise





Saltwater intrusion in S. Florida









Abrupt elevation loss is occurring where freshwater marshes are becoming saltier



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- In coastal zones, the ability to maintain <u>elevation</u> in the face of sea level rise
- Hurricanes as resilience agents by:
 - Stimulating recruitment
 - Building soil and sediment
 - Delivering nutrients
 - Replenishing freshwater



Historic Flow

Current Flow

Restored Flow

Florida Coastal Everglades LTER

How do long-term changes in climate, disturbance, and water management interact with ecosystem functions in the coastal zone?

Based at FIU, the FCE LTER includes 73 scientists, 56 students from 29 academic institutions, agencies and NGOs.

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General Stress Hurricanes are Frequent Visitors to the FCE

GULF

OF MEXICO

Hurricane Wilma GOES-12 Colorized IR 4 KM October 24, 2005 @ 1132 UTC

Hurricane Wilma

- October 25, 2005
 - Category 2-3
- 120 mph winds
- 8 ft surge

Windrows

Periphyton outlines ridges and reinforces ridge-slough topography Gulf of Mexico EVERGLADES

5 MILES

Defoliation Extensive defoliation of the mangrove forests

eda

Casta

0

Mangroves

Attenuate storm surge

1 h

Storm surge

Significant P-rich mud deposit in mangrove forests

Gulf of Mexico EVERGLADES

Mud deposit

~ 50 years of mangrove-built soil

Mud deposit

- ~ 50 years of mangrove-built soil
- = "upside-down" P supply

Forest recovery

= fastest where P-rich soils thickest

Twelve years of relative solitude

Hurricane Jrma

- September
 10, 2017
- Category 2-3
- 115 mph winds
- >8 ft surge

Acoustic telemetry

Bull sharks found by receivers 100 km away

Acoustic telemetry

Highest number of snook recruits ever recorded

Goddard's LiDAR Hyperspectral & Thermal Imager (G-LiHT)

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Florida Bay

Atlantic Ocean 5 MILES

Florida Bay without water on 9-9-17

Florida Bay with dead seagrass on 9-25-17

Pre-storm loss of 1.5 ft below low tide, then 6 ft surge above high tide

Storm Deposit

- Up to 10 cm of Gulf of Mexico mud
- ~ 100 years of forest accumulation

Mud

deposit

Mangrove

soil

Flood waters - Highest on record - new bridges allowed emergency ops

Atlantic Oceanie

Gulf of Mexico

Flood waters

- Highest on record - new bridges allowed emergency ops

Carbon export

Flood waters moving carbon out of the Everglades

Is the carbon coming from here?

Coastal Resilience

The ability of marshes to maintain elevation in the face of sea level rise may be compromised by reduced freshwater flows

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Coastal Resilience

 Hurricanes may stimulate physical, biological and human behavioral changes that build resilience to sea level rise

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