COUPLED SOIL CARBON MEASUREMENTS AND REMOTE SENSING TO QUANTIFY ABOVE AND BELOWGROUND CARBON STOCKS IN MANGROVE FOREST OF THE TEN THOUSAND ISLANDS REGION OF SOUTHWEST FLORIDA, USA

Burial and Storage of Carbon
“Blue Carbon”

Mapping and Predicting Future Storage
Remote Sensing, Soil Coring and Biogeochemistry
Ten Thousand Islands

Marco Island

Naples

Rookery Bay

Blackwater Bay

Faka Union Bay
Aboveground Vegetation

- G-LiHT and Ground-truthing sites selected under G-LiHT flight path
- 10 x 10-m plots
  - Tree height
  - Trunk diameter
G-LiHT Canopy Height
G-LiHT  Aboveground Biomass
Aboveground Biomass (AGB)

AGB calculated in two ways:
- G-LiHT data and Simard et al. 2006
- Tree density and trunk diameter calculations (ground-truthing data)

Large differences indicate need for region-specific equation for small trees (5-10 m)
- Most published AGB vs. height equations are for tall mangroves
- Need to expand range of heights & create robust local equation

![Graph showing aboveground biomass vs. tree height](image1)

\[
y = 28.342x - 83.803 \\
R^2 = 0.8977
\]
Belowground Carbon Stock

Preliminary Estimates

Loss-on-ignition to determine sedimentary organic matter content

LOI converted to Organic Carbon from existing equations

Sediment analyzed in 1- to 2-cm intervals to 40 cm depth
**Total Organic Carbon Stocks**

- **Total carbon 213 – 244 Mg/ha**
  - Belowground organic C 152 – 173 Mg/ha (n = 4)
  - Aboveground organic C 42 – 84 Mg/ha (n = 7)

*No vegetation plot or G-LiHT flight path near site*
Comparing Mangrove Forest Organic Carbon Stocks

Shark River*
10K Islands
Tampa Bay**

*Castaneda-Moya et al (in prep)
**Radabaugh et al. 2017

Alongi DM. 2014.
Ten Thousand Islands

Organic Carbon Burial Rates \((g m^{-2} yr^{-1})\)

Regional 90% C.I.
10-Year: 166 ± 33
50-Year: 131 ± 18
100-Year: 103 ± 20
Organic Carbon Burial Rates (g m\(^{-2}\) yr\(^{-1}\))

10K Islands 90% C.I.
- 10-Year: 166 ± 33
- 50-Year: 131 ± 18
- 100-Year: 103 ± 20

Florida 90% C.I.
- 10-Year: 188 ± 22
- 50-Year: 149 ± 15
- 100-Year: 114 ± 12

Global*
- 100-Year: 163

*Breithaupt et al., Global Biogeochemical Cycles, 26, 2012.
Everglades National Park

Organic Carbon Burial Rates

- OC Burial (g m$^{-2}$ yr$^{-1}$)

- "The Dip"

- 0-10 km
- ~Tarpon Bay
- Upstream Mangrove
Accretion Rates (mm yr\(^{-1}\))

10K Islands 90% C.I.
10-Year: 4.1 ± 0.8
50-Year: 3.2 ± 0.3
100-Year: 2.3 ± 0.3

Florida 90% C.I.
10-Year: 4.0 ± 0.4
50-Year: 3.2 ± 0.2
100-Year: 2.3 ± 0.2
Timeframes of vulnerability to sea-level rise

- With Accretion at 4.6 mm yr\(^{-1}\)
- Under 6.9 mm yr\(^{-1}\) SLR Scenario
  - Loss occurs in about 200 years
- Under 12.7 mm yr\(^{-1}\) SLR Scenario
  - Loss occurs in less than 70 years
Summary

- Total Organic Carbon Stocks: 213-244 Mg ha\(^{-1}\) (minimum)

- Organic Carbon Burial Rates: 103 ± 20 g m\(^{-2}\) yr\(^{-1}\) (100 year)

- Mangrove forest accretion has been keeping pace with SLR on the 100 and 50 year time scale. However, some sites may be submerged in ~70 years.
Thank you.
Belowground Carbon Stock

Need line for reference
40 cm potential to be much higher, use burial rate to estimate
Tide Gauge Data

Key West 1913
St. Petersburg 1947
Fort Myers 1965

10-Year Rate 6.9 mm/yr
50-Year Rate 2.8 mm/yr
100-Year Rate 2.2 mm/yr