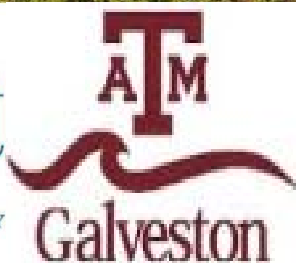


Changes in mangrove versus marsh cover alters the storage, inputs and breakdown of organic carbon: Evidence from a large-scale field manipulation in Coastal Texas

Sean Charles, Anna Armitage, Sayantani Dastidar, Paolo D'Odorico, Jose Fuentes, Hongyu Guo, Zoe Hughes, John Kominoski, Steve Pennings, Carolyn Weaver, Ashley Whitt



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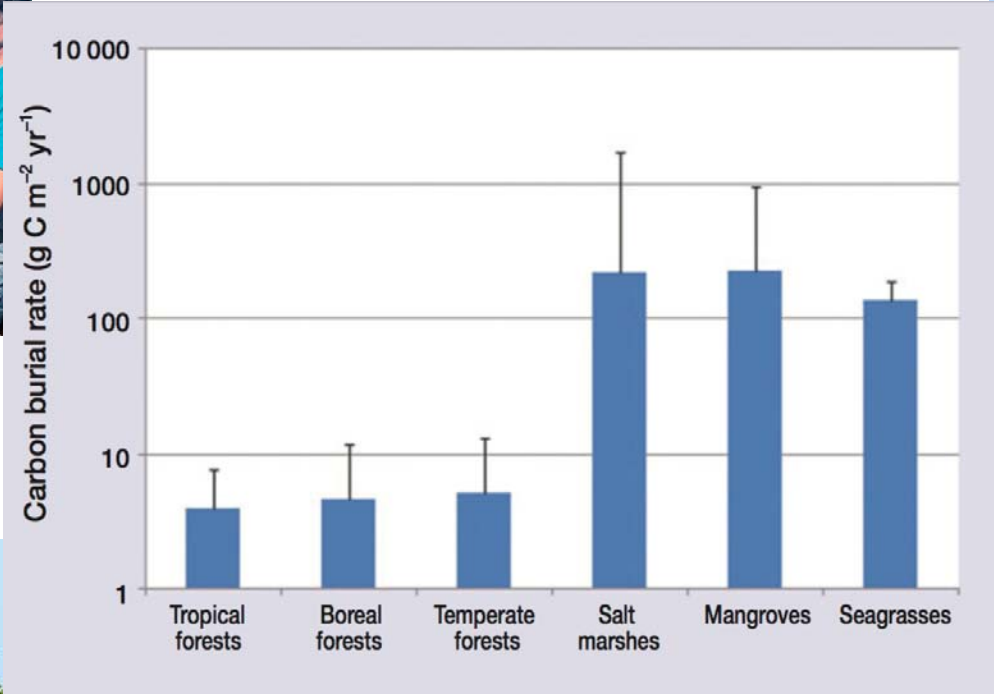


Dr. Jose Fuentes

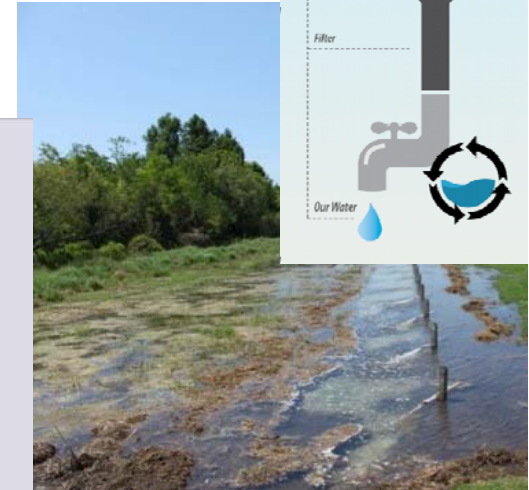
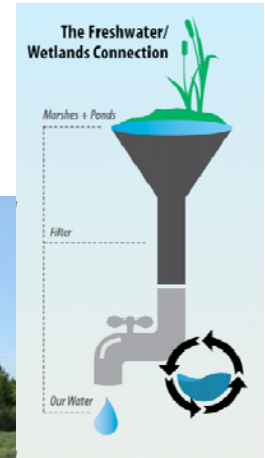


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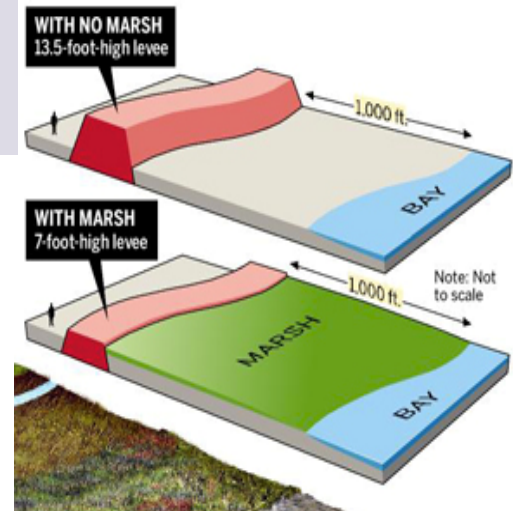
Coastal wetland services



Mcleod et al. 2011



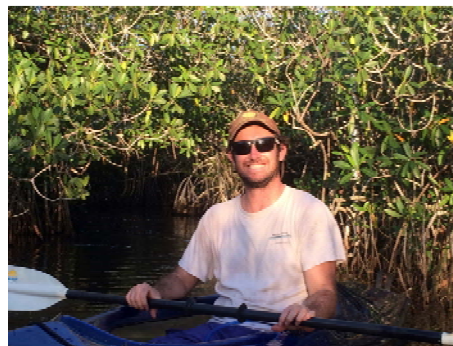
Water Quality



Coastal Buffering

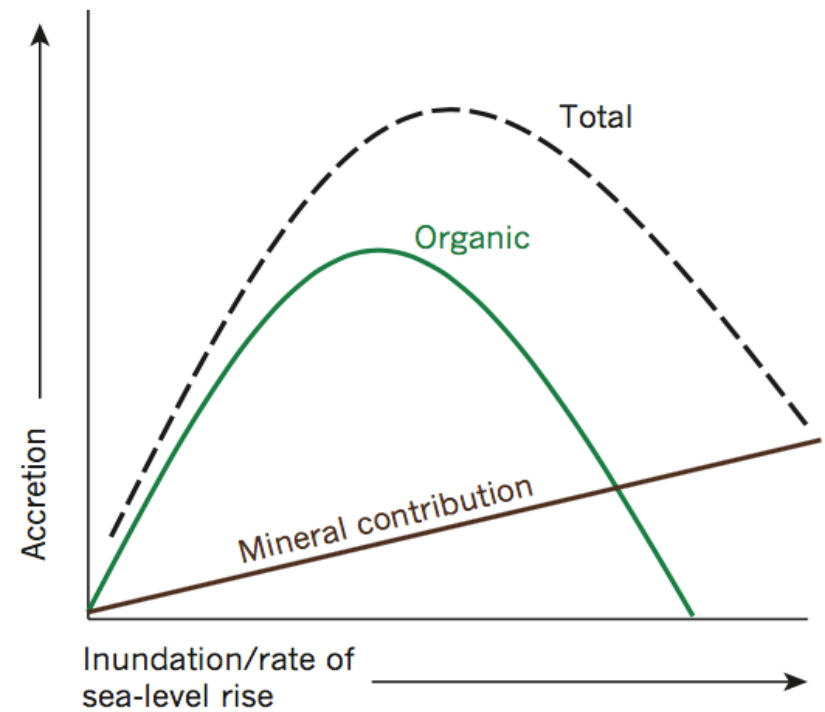
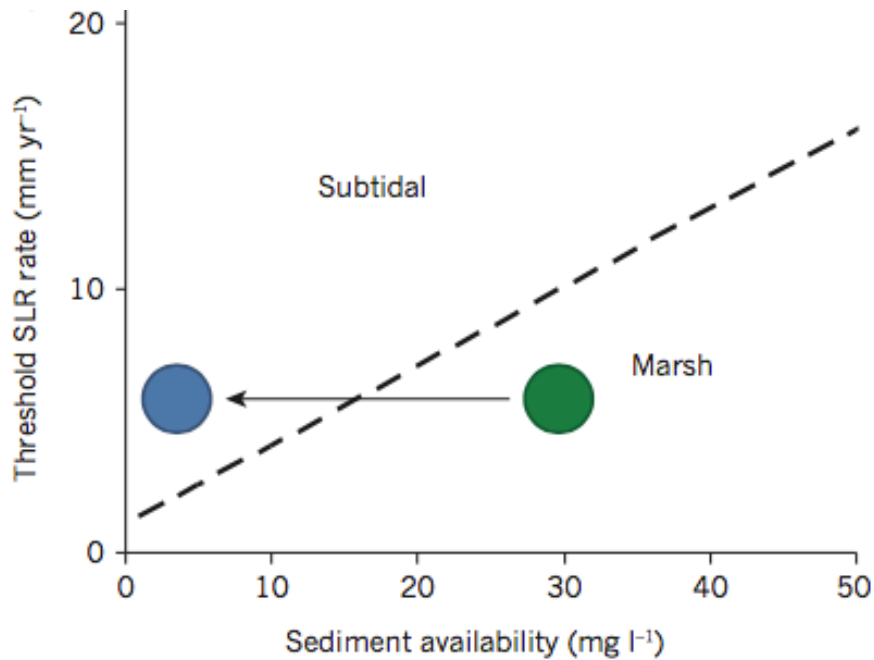


Habitat

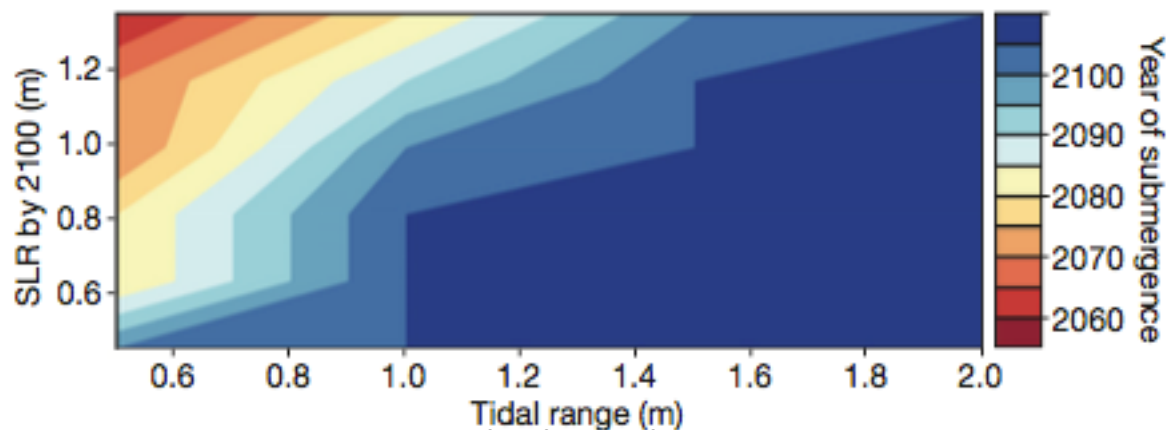


Recreation

Coastal wetlands accrete or perish

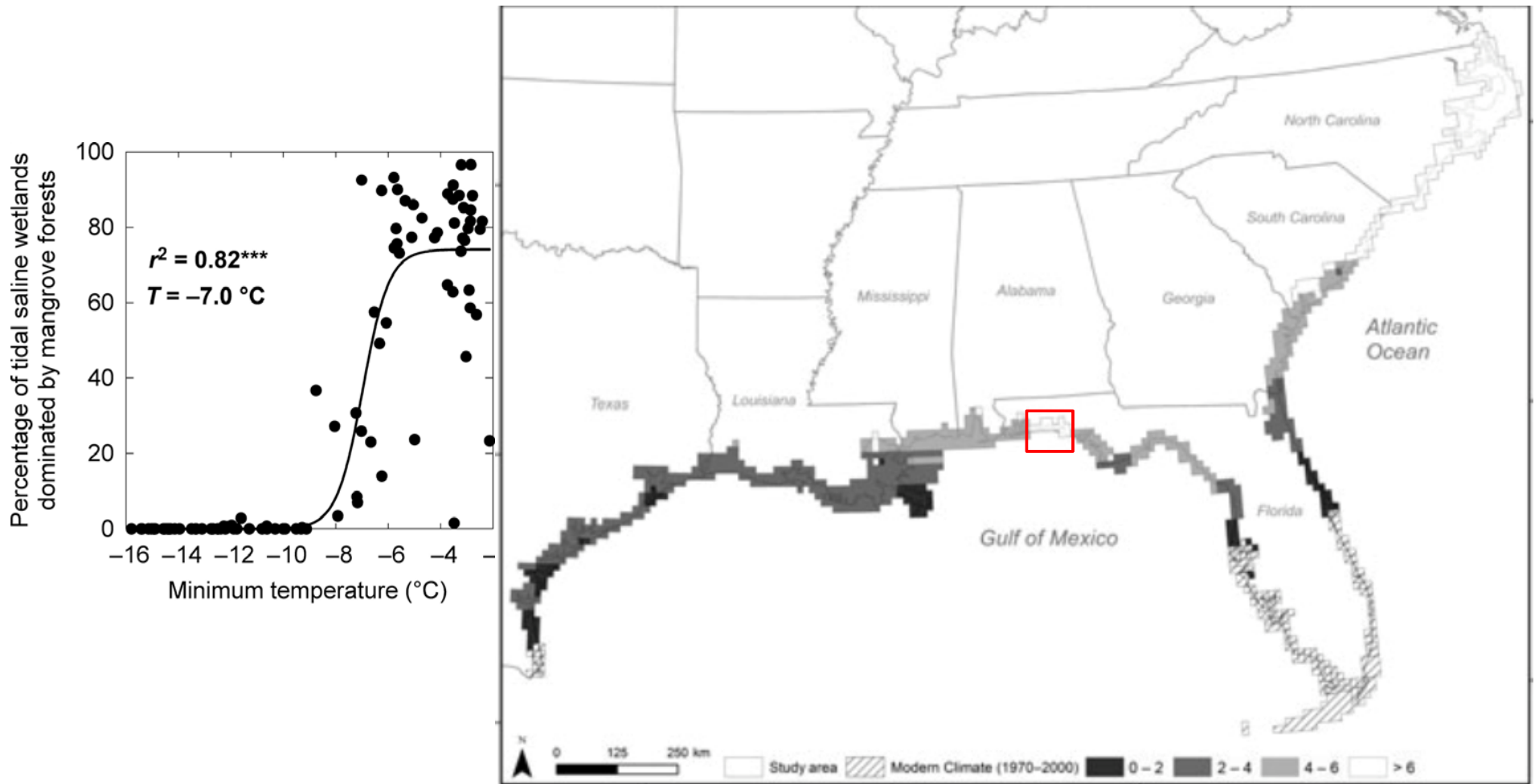


Kirwan and Megonigal 2013



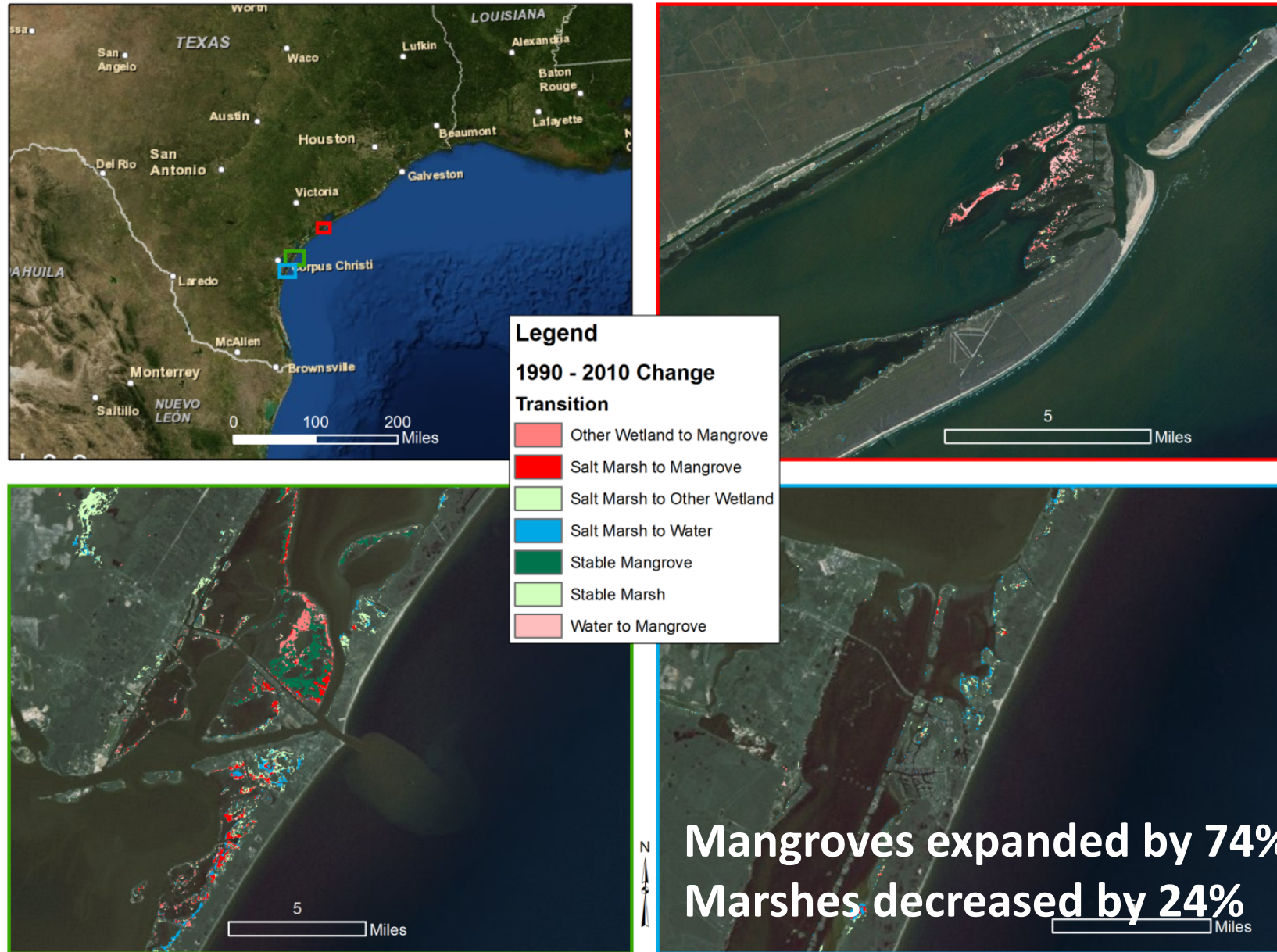
Lovelock et al. 2015

Saltmarsh is Going, Going, G.O.M.



Temperature increases predicted to create mangrove dominance (Osland et al. 2013)

Texas Mangroves expanded 74% in 20 years



Armitage et al. 2015

But, mangroves also dieback

- Cedar Key 1995-96 mangrove ~90% dieback (Stevens et al. 2006)



Biscayne Bay, FL 2001



Shark River, FL 2010

Photo Credit Mike Ross

And exist in dynamic ecotones

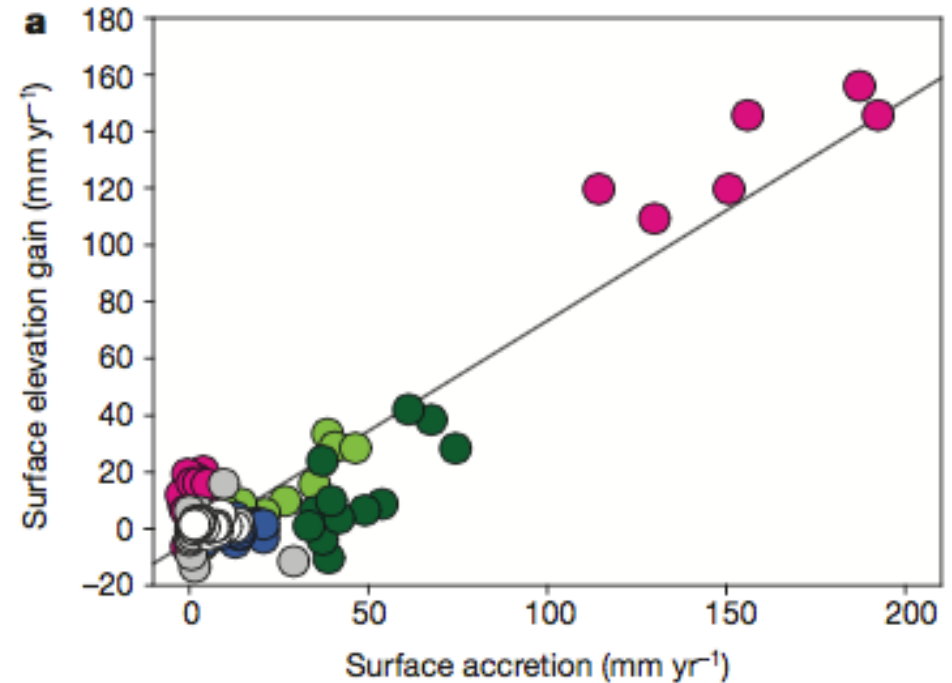
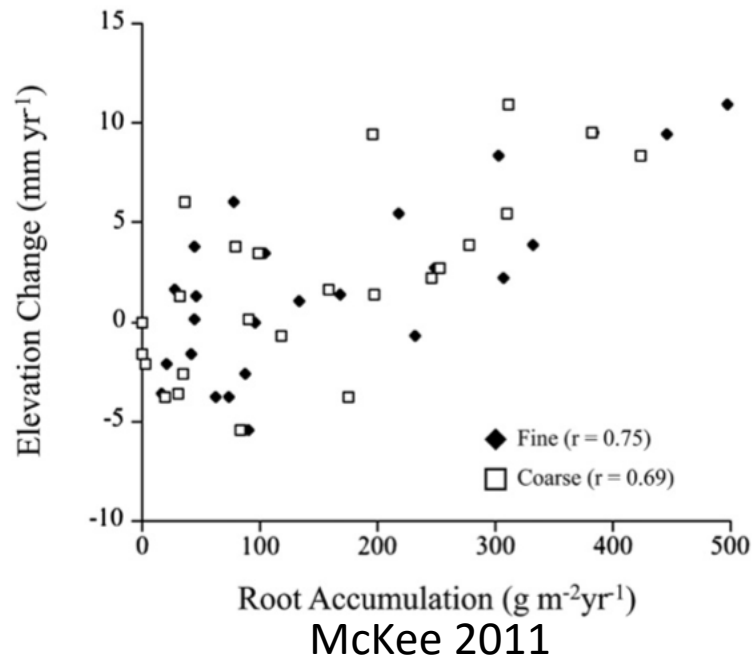


How does vegetation identity (marsh vs. mangrove) and cover alter processes that drive carbon storage and accretion?



How do coastal wetland soils accrete?

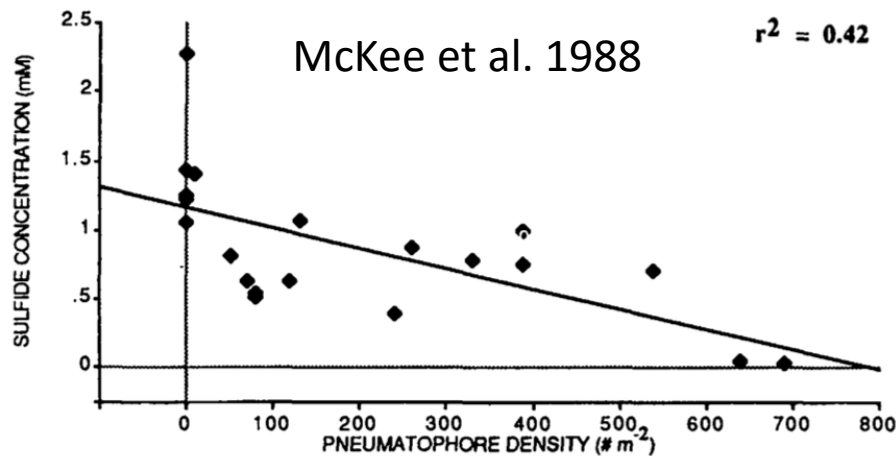
- Surface deposition
 - Allochthonous
 - Autochthonous
- Root accumulation
- Slow OM breakdown



Lovelock et al. 2015

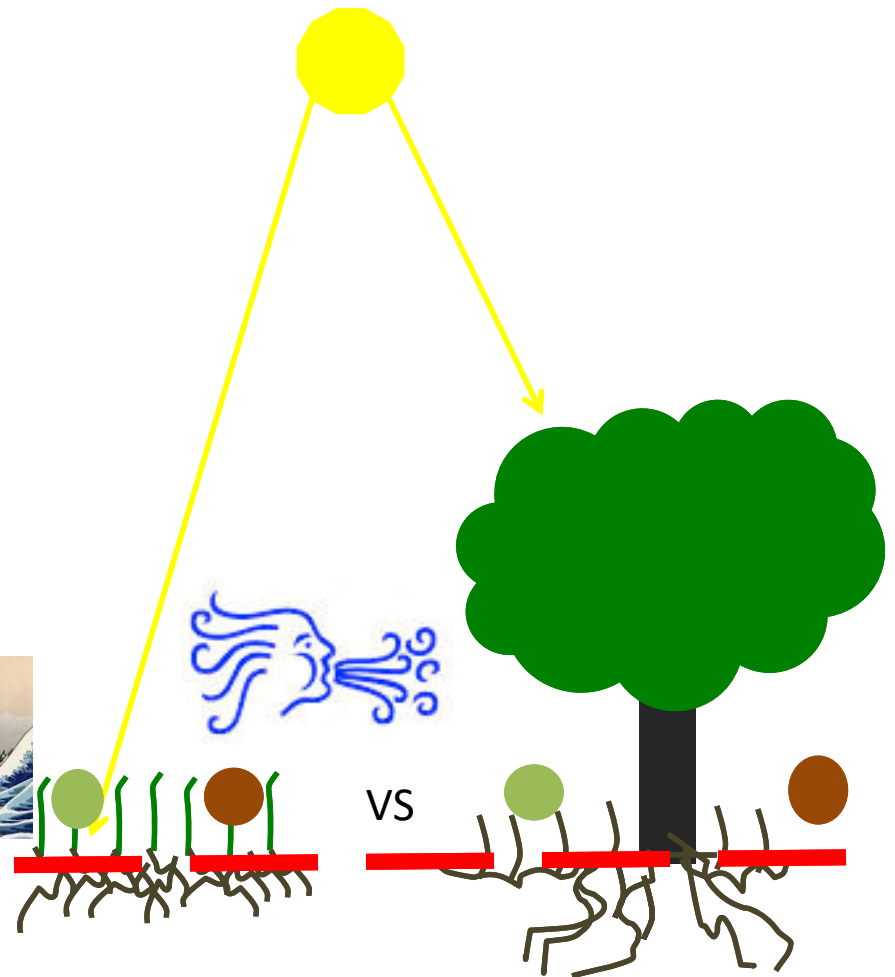
Plants influence C storage

- Fix carbon
 - Quantity, Quality, Allocation



McKee and Faulkner 2000

- Influence allochthonous deposition
- Alter microclimate
- Prime and aerate soils

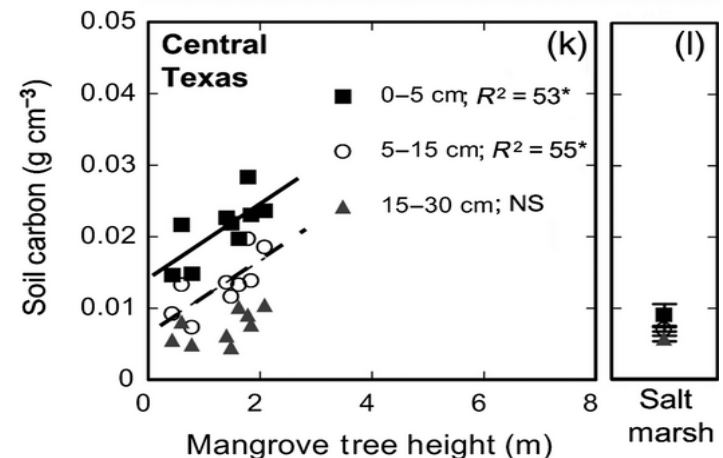
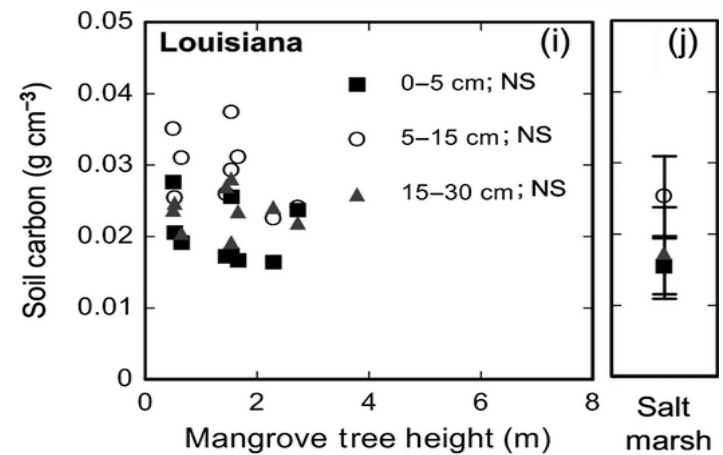
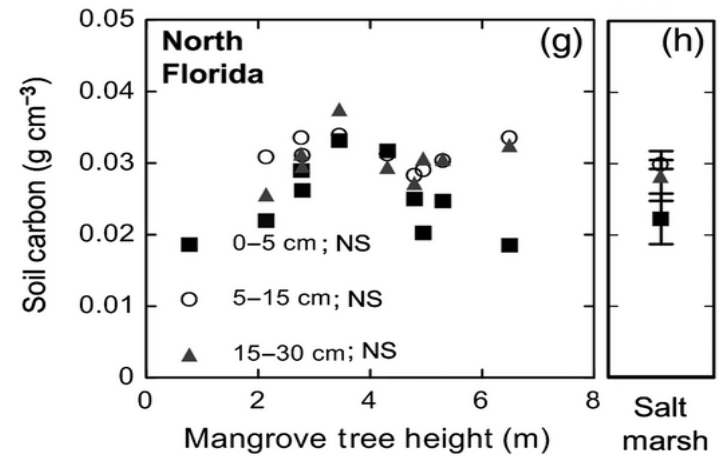


...but no clear pattern of soil C change with mangrove encroachment

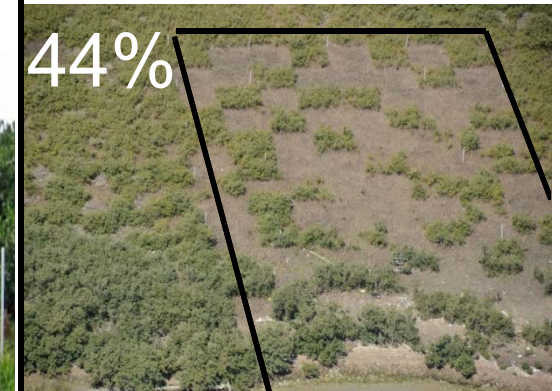
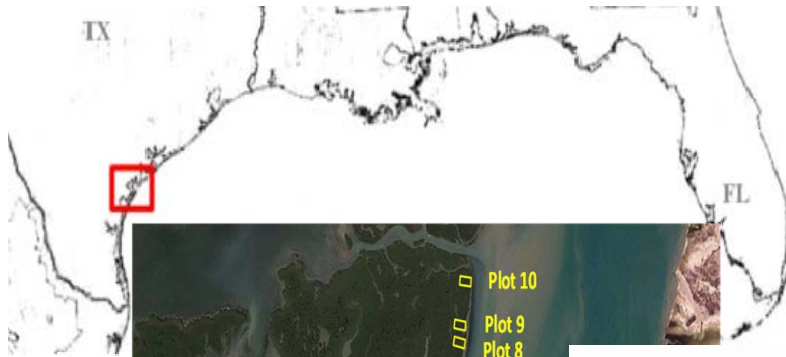
Increase: Bianchi et al. 2013; Comeaux et al. 2013; Kelleway et al. 2016

No Change: Perry and Mendelsohn 2009; Henry 2012; Henry and Twilley 2013; Doughty et al. 2015

Case Dependent: Yando et al. 2016

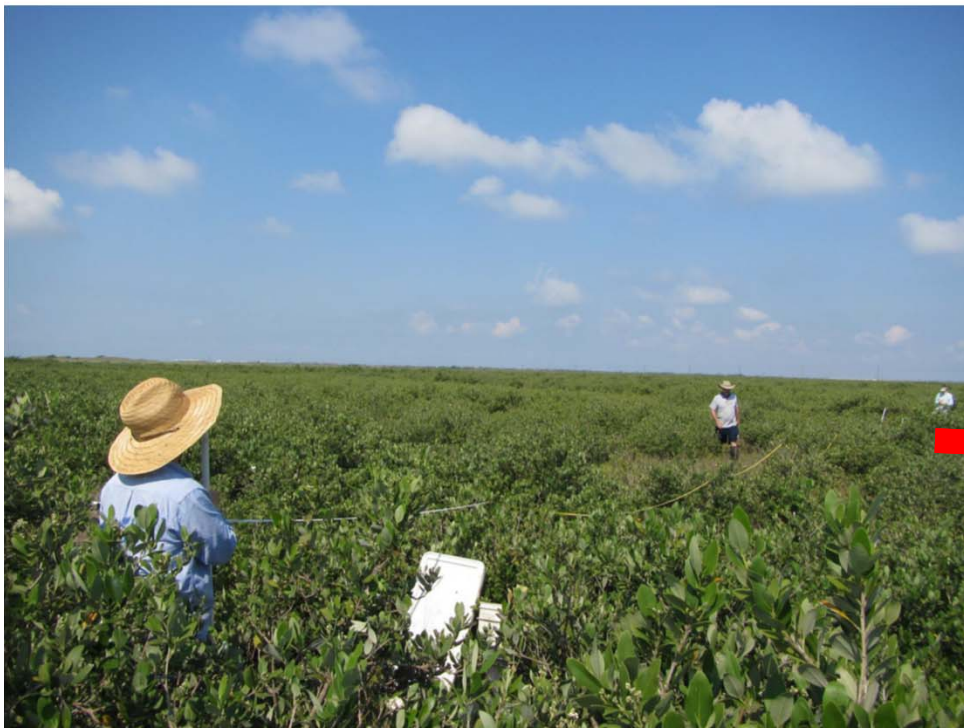


Experimental Design



- 10 (24 x 42 m) plots of differing mangrove/marsh density

Site Creation



Methods

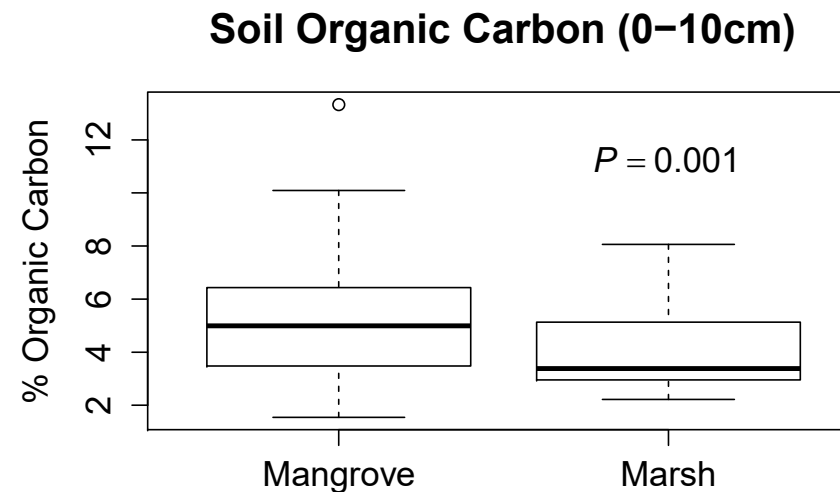
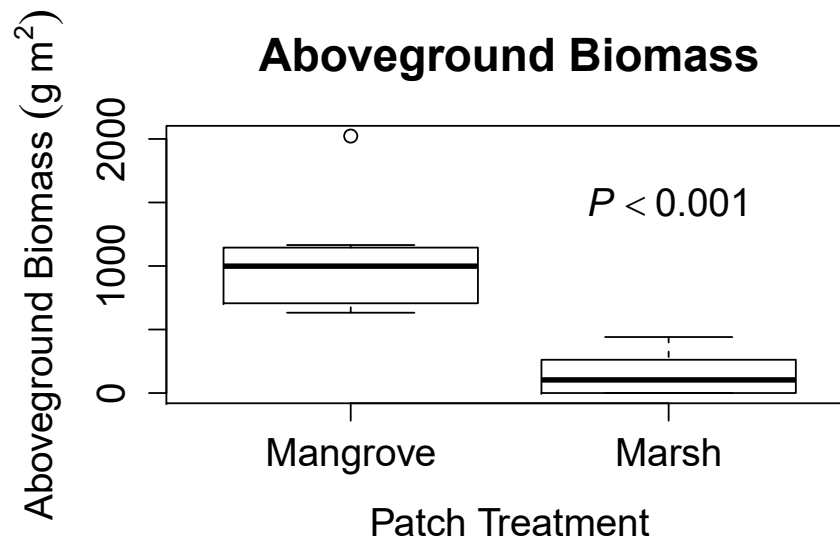


- Total Organic C Stocks
 - Aboveground biomass (clip plots and allometric equations)
 - Belowground biomass (0-30 cm)
 - Soil (0-10 cm)
- Rates of C Inputs
 - Root productivity (0-30 cm ingrowth bags)
 - Surface accretion (Feldspar plots)
- Rates of C breakdown
 - Litter breakdown (*Avicennia germinans* and *Batis maritima*)
 - Root breakdown
 - Standard substrates (wood and cellulose above and belowground)



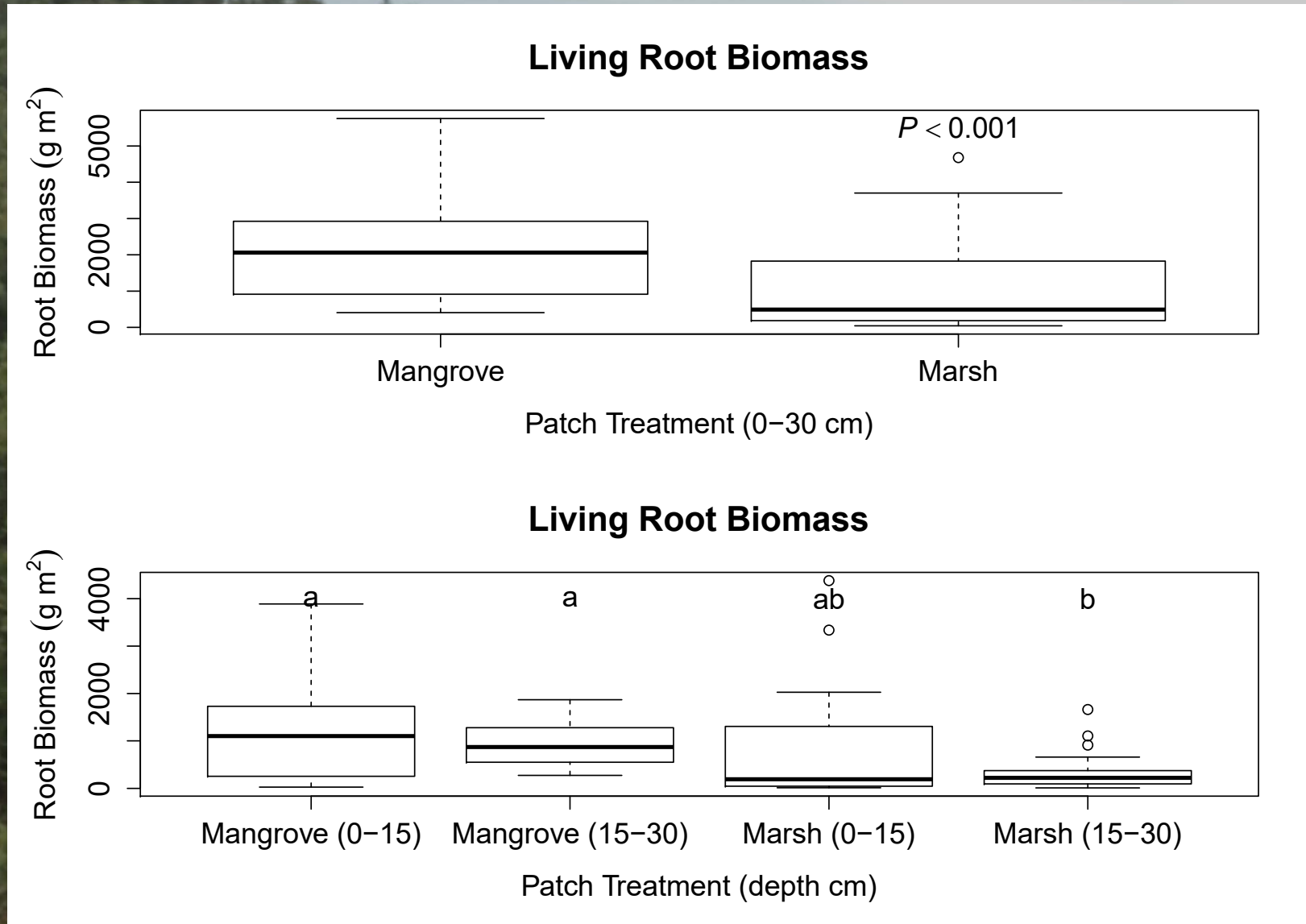
C stocks: Higher aboveground biomass and soil C

- *Avicennia g...*

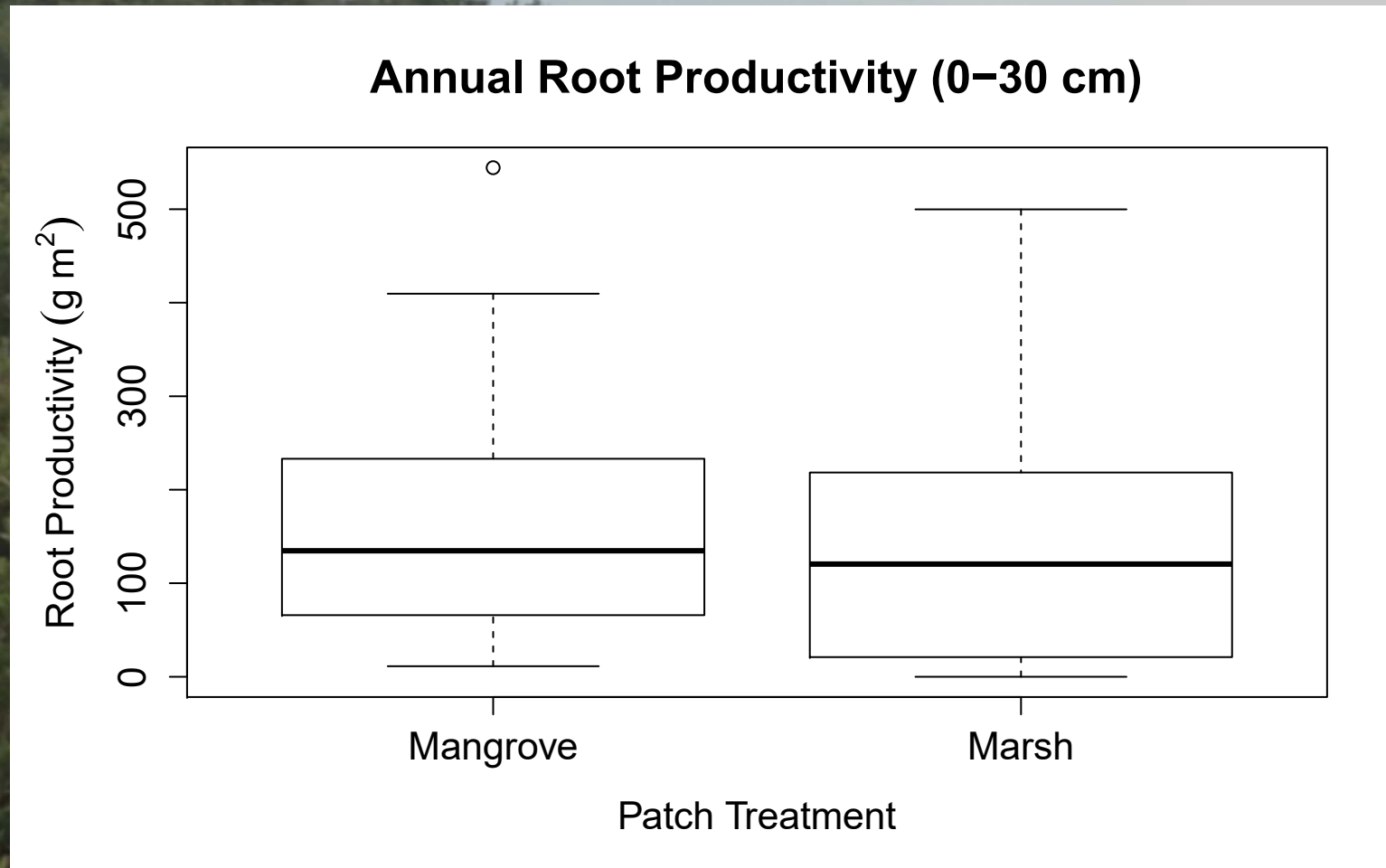


*a, Salicornia
cornia
rtina
sesuvium,
m,
nium*

C stocks: Greater and deeper root biomass

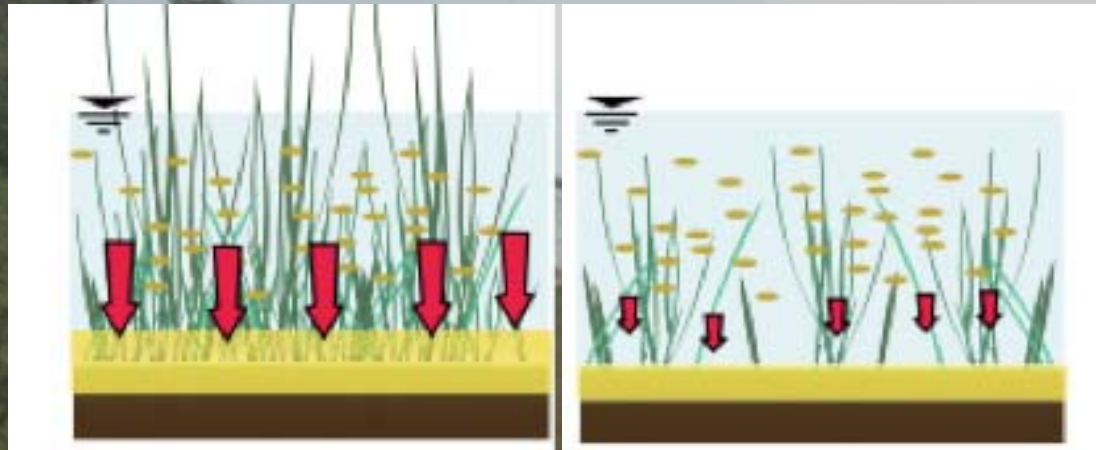


C inputs: Similar root productivity higher root longevity

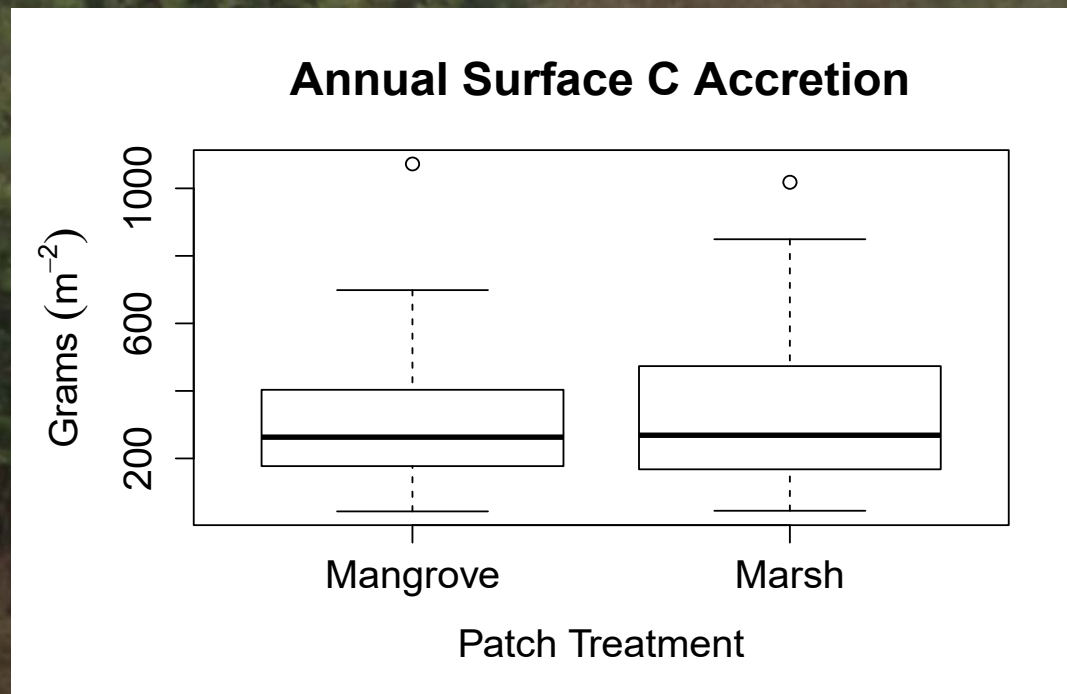


Turnover: 0.08 y^{-1} 0.14 y^{-1}

C inputs: More Biomass= More accretion?

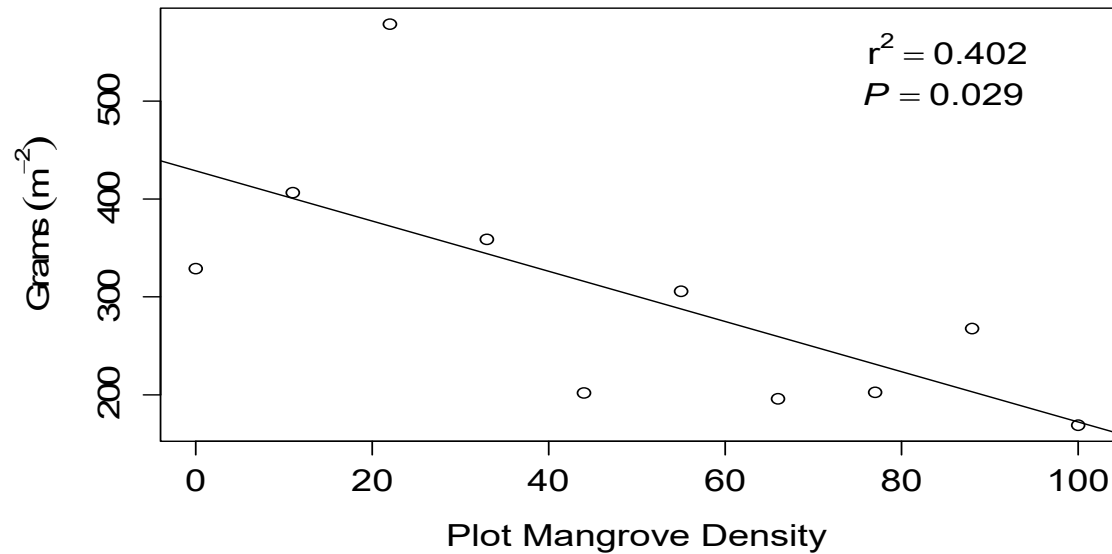


Fagherazi et al. 2012

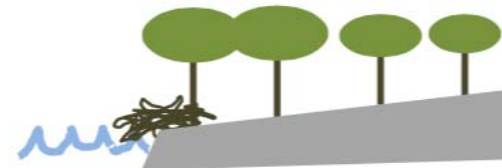


C inputs: Mangroves restrict subsidies to wetland interior

Annual Surface C Accretion



Beach



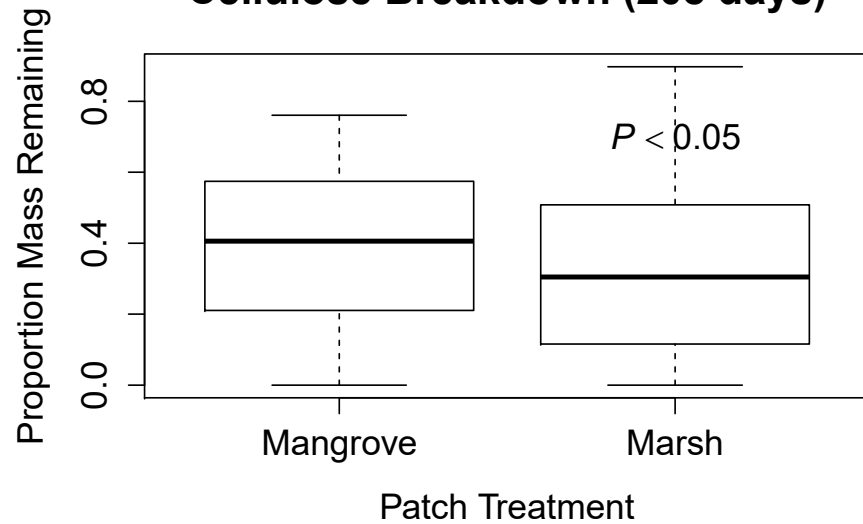
Mangrove



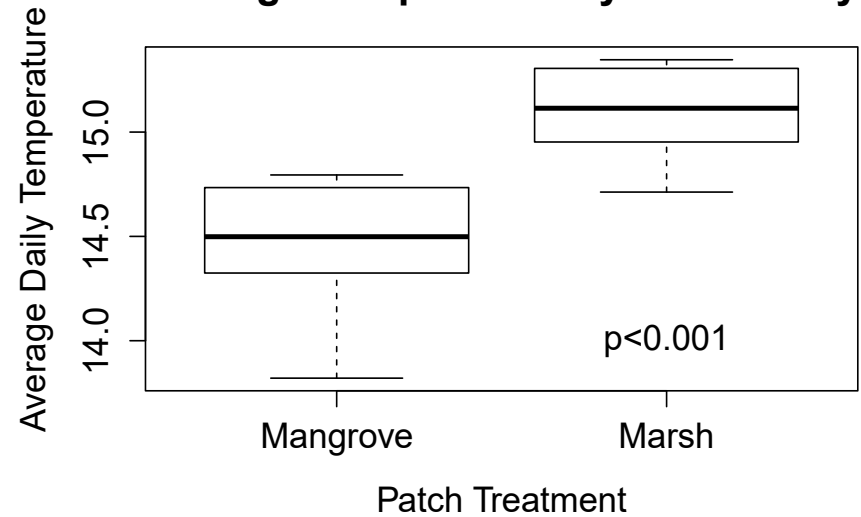
Marsh

C breakdown: Mangroves reduce surface breakdown

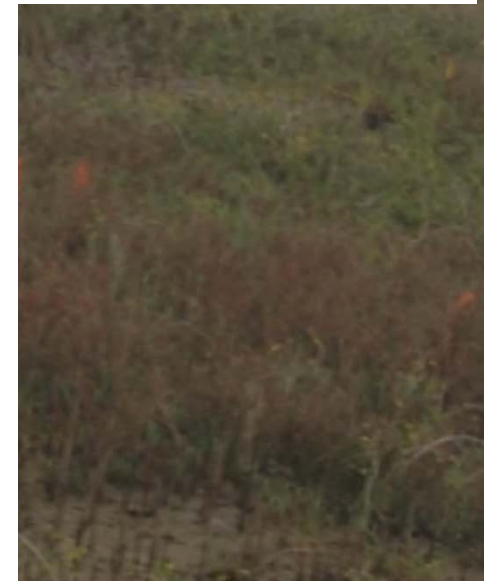
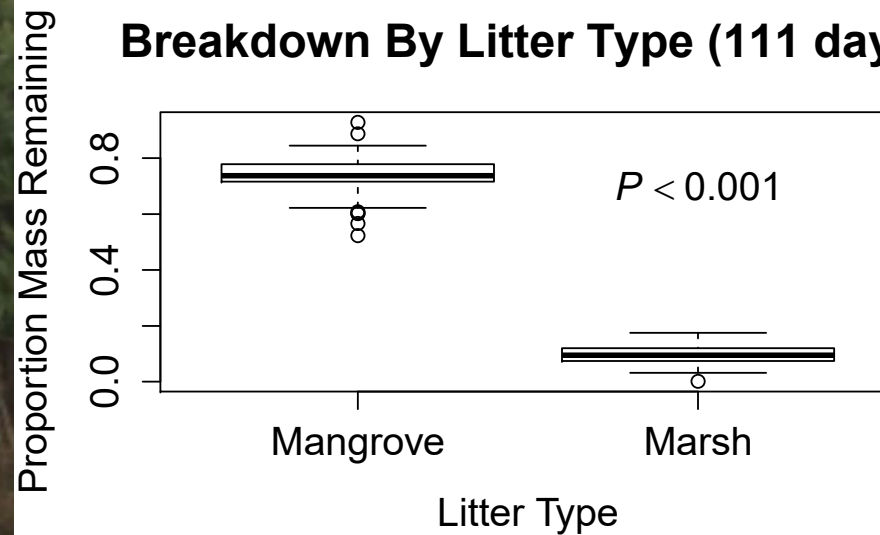
Cellulose Breakdown (208 days)



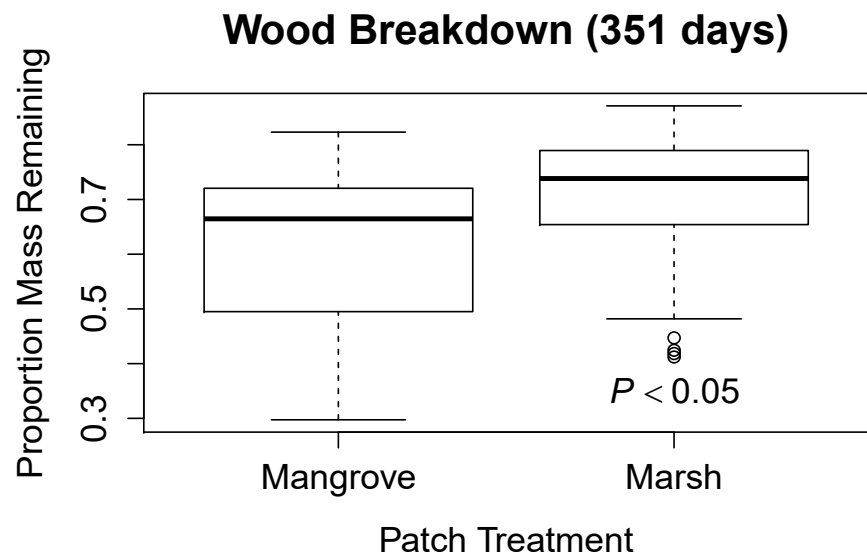
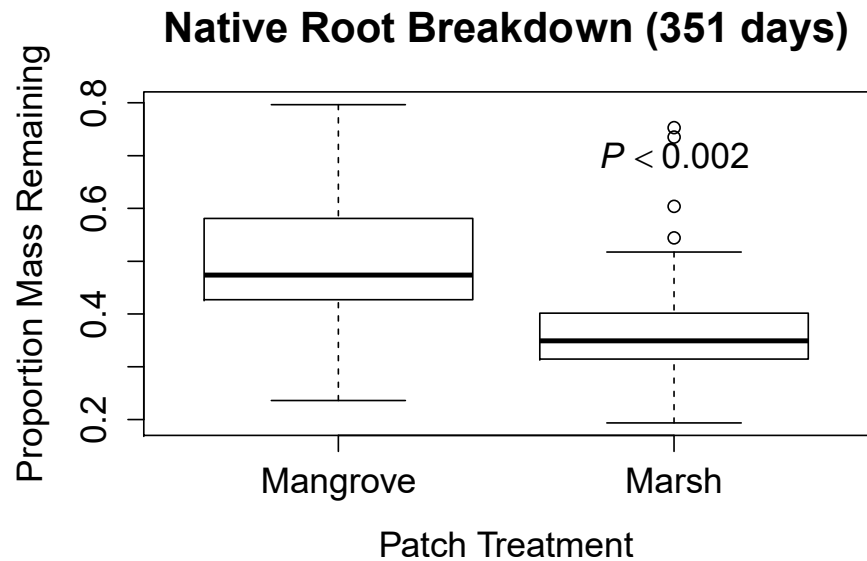
Average Temperature by Community



Breakdown By Litter Type (111 days)

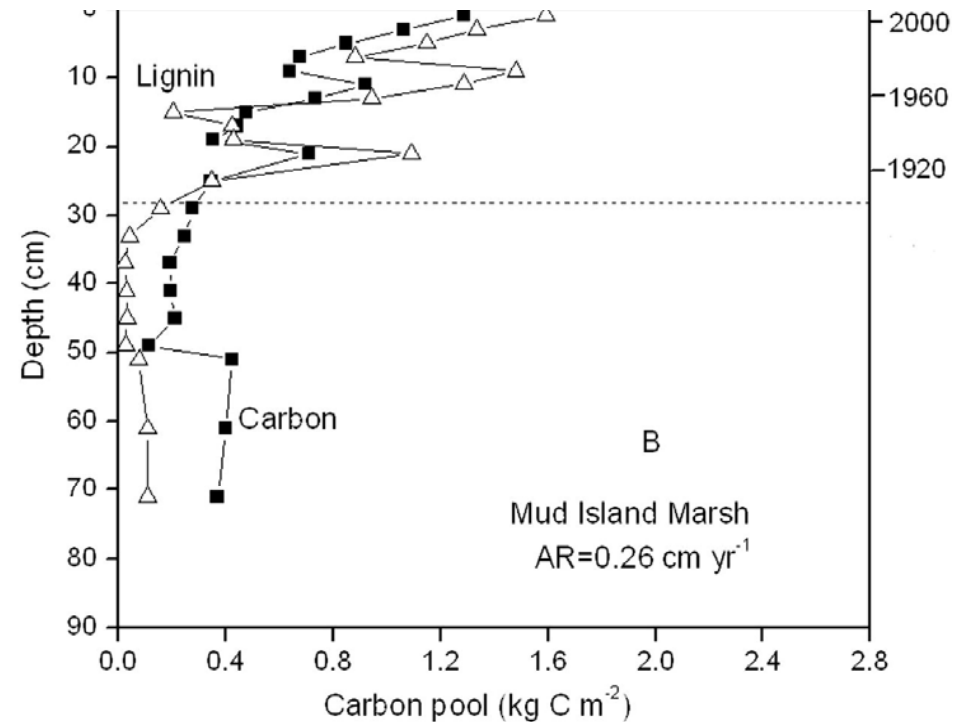
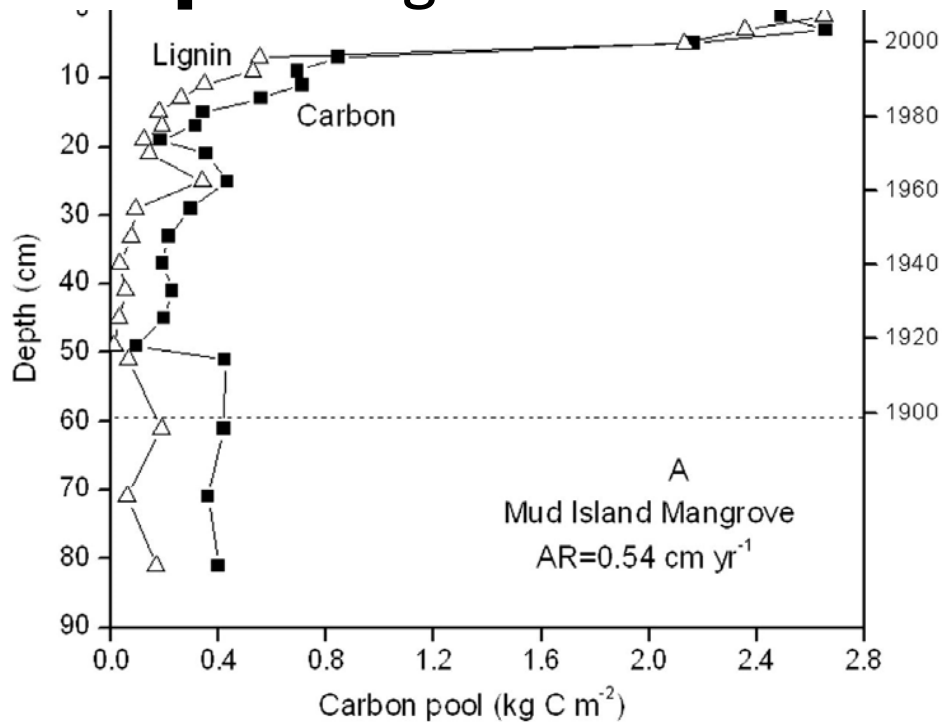


C breakdown: Mangrove roots breakdown slowly, but increase subsurface breakdown rate



How did mangrove cover impact carbon stocks and storage processes?

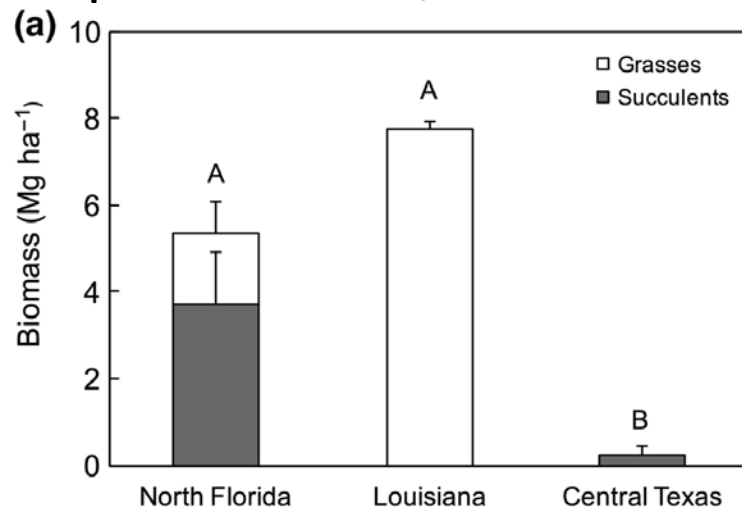
- C stocks
 - ↑ Biomass
 - ↑ soil organic matter



Does GOM mangrove encroachment increase C storage?

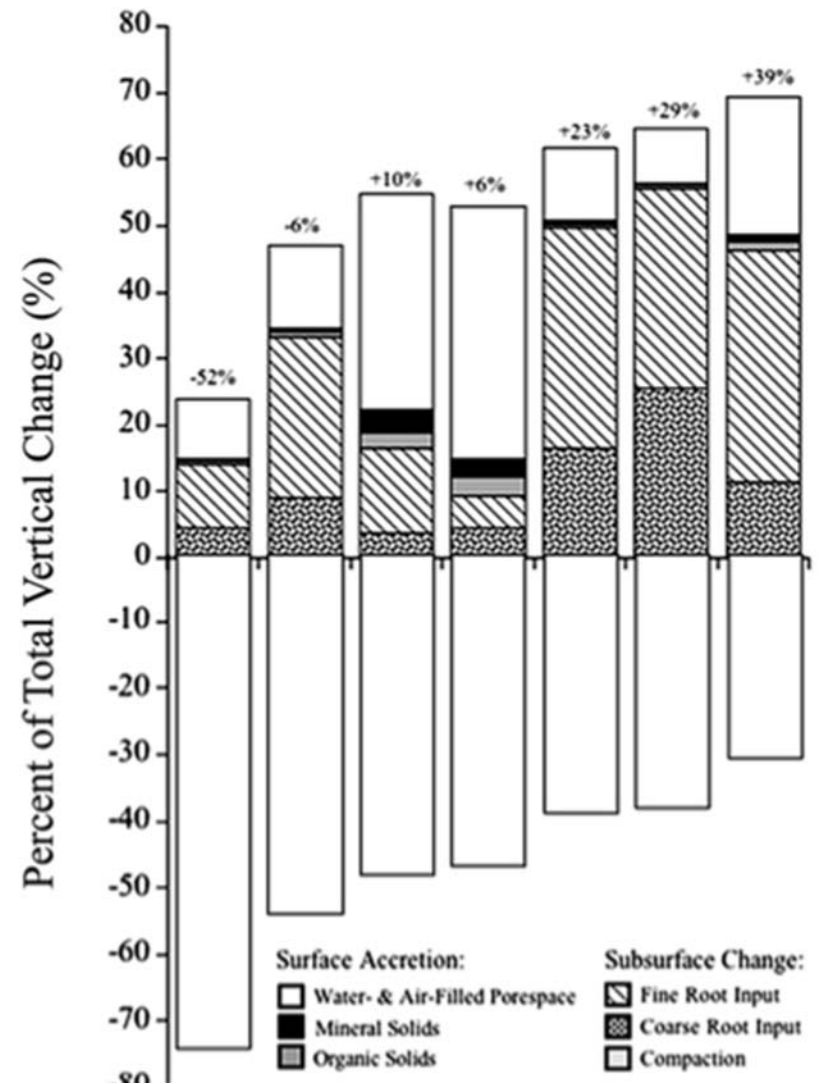
Maybe! (Yando et al. 2016)

- Environmental conditions (Knapp et al. 2008)
- Species traits (Kominoski et al. 2013)



Yando et al. 2016

- Edaphic Conditions
- Time
- Source of accretion (McKee 2011)



McKee 2011



Acknowledgements



Principal Investigators

Steve Pennings, Anna Armitage, John Kominoski

Coauthors

Hongyu Guo, Carolyn Weaver, Ashley Whitt, Sayantani Dastidar, Paolo D'Odorico, Jose D. Fuentes, John Kominoski, Anna Armitage, Steve Pennings

Undergraduate volunteers

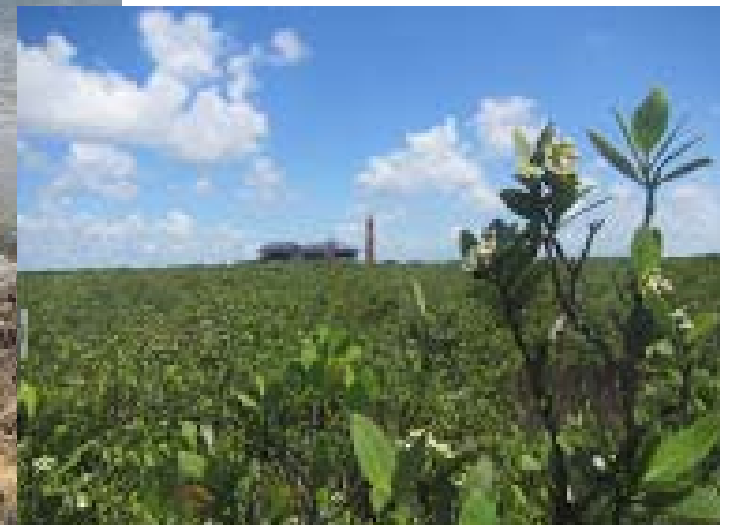
Kristina Morales, Daniel Rivera, Claudia Garcia, Hilda Deleon, Alexis Ramos, Marco Fernandez

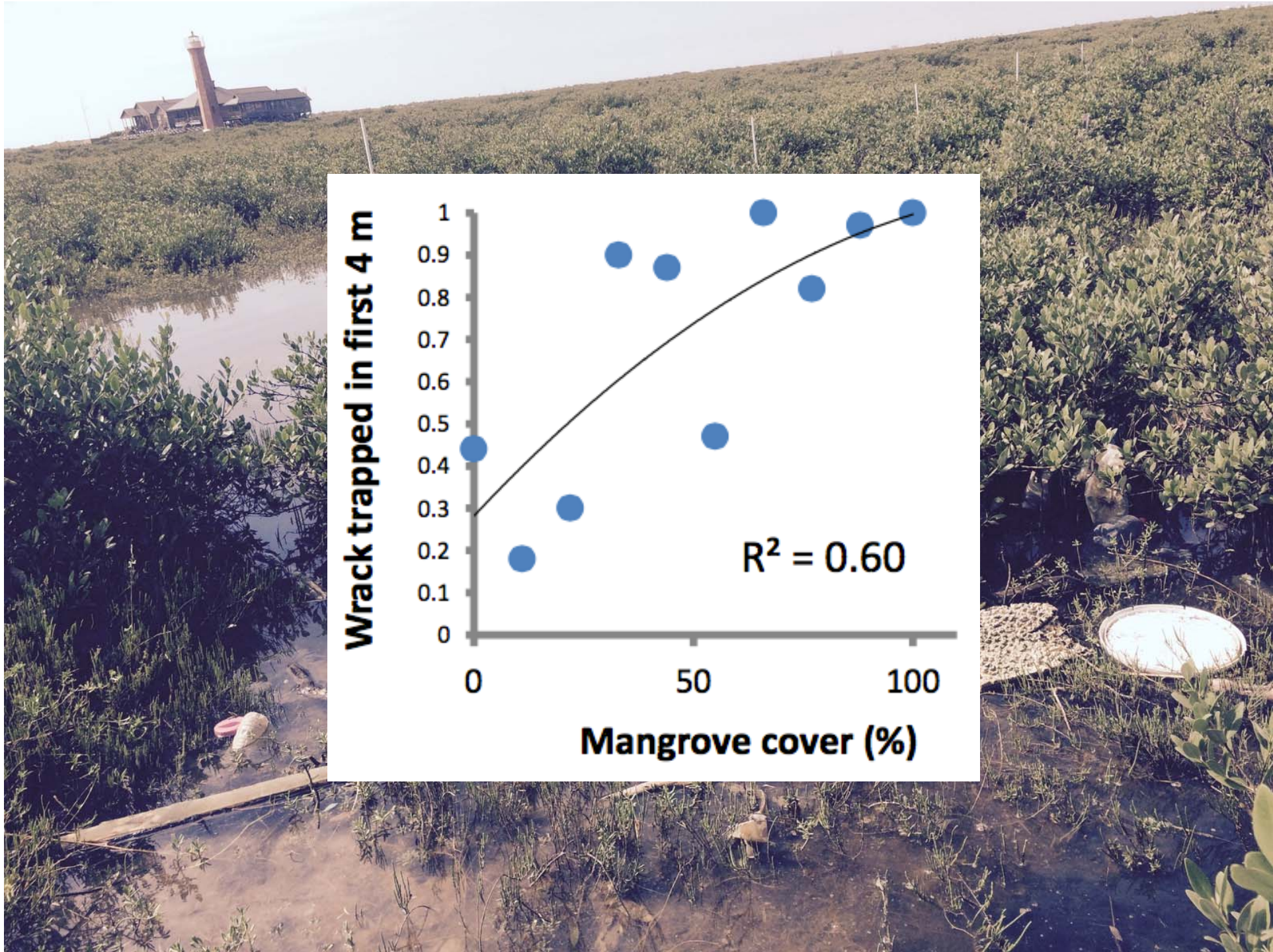
Many others!



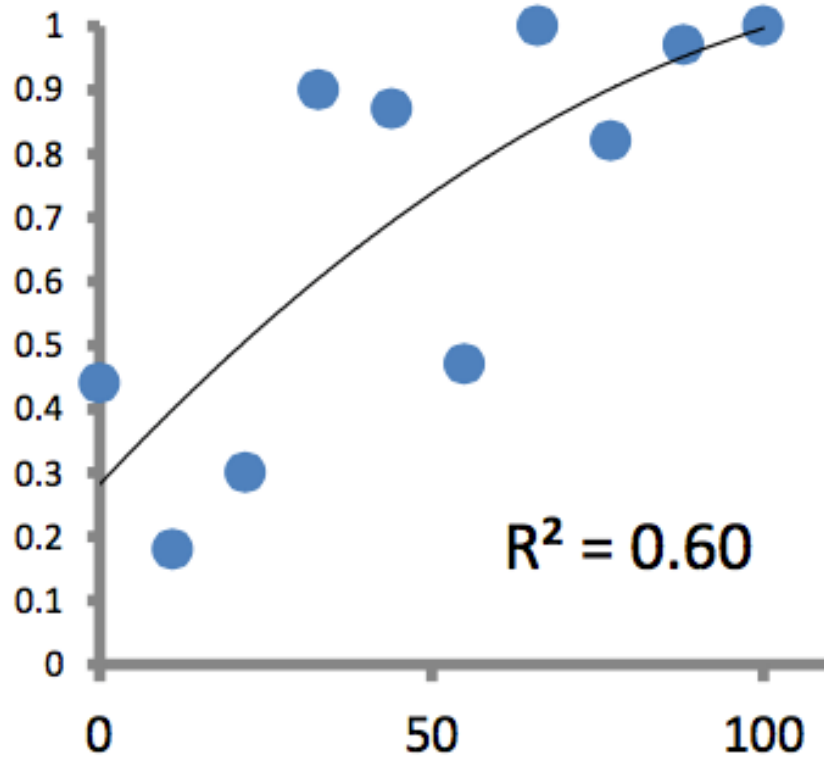


Questions?
schar056@fiu.edu





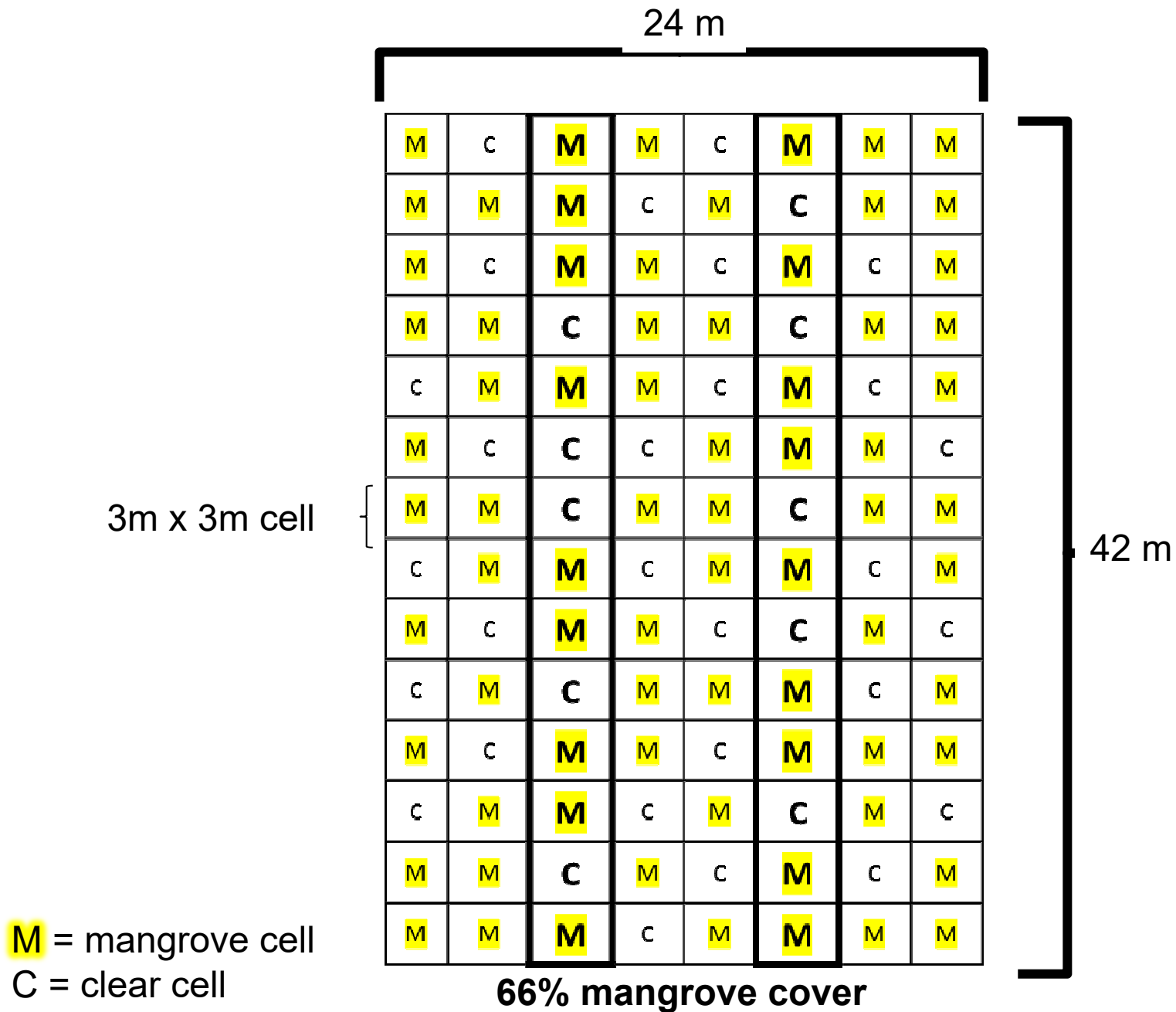
Wrack trapped in first 4 m



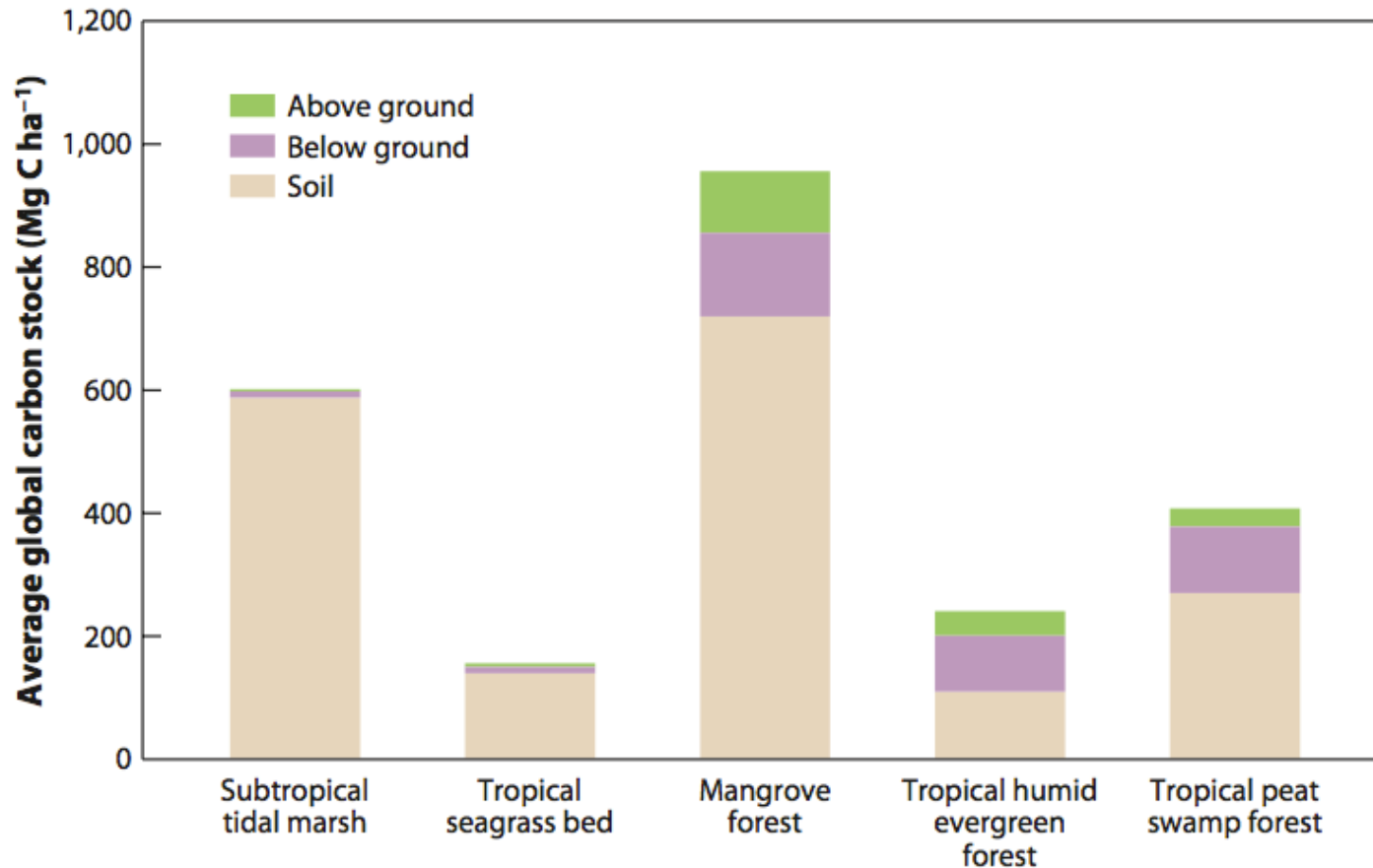
$R^2 = 0.60$

Mangrove cover (%)

Mangrove cover experimental manipulation



Are mangroves or marshes better C sinks?



Alongi 2014

Yet for carbon **sequestration**:

Mangroves = $174 \pm 23 \text{ g C m}^{-2} \text{ y}^{-1}$

Saltmarshes = $218 \pm 24 \text{ g C m}^{-2} \text{ y}^{-1}$

(Chmura et al. 2003)