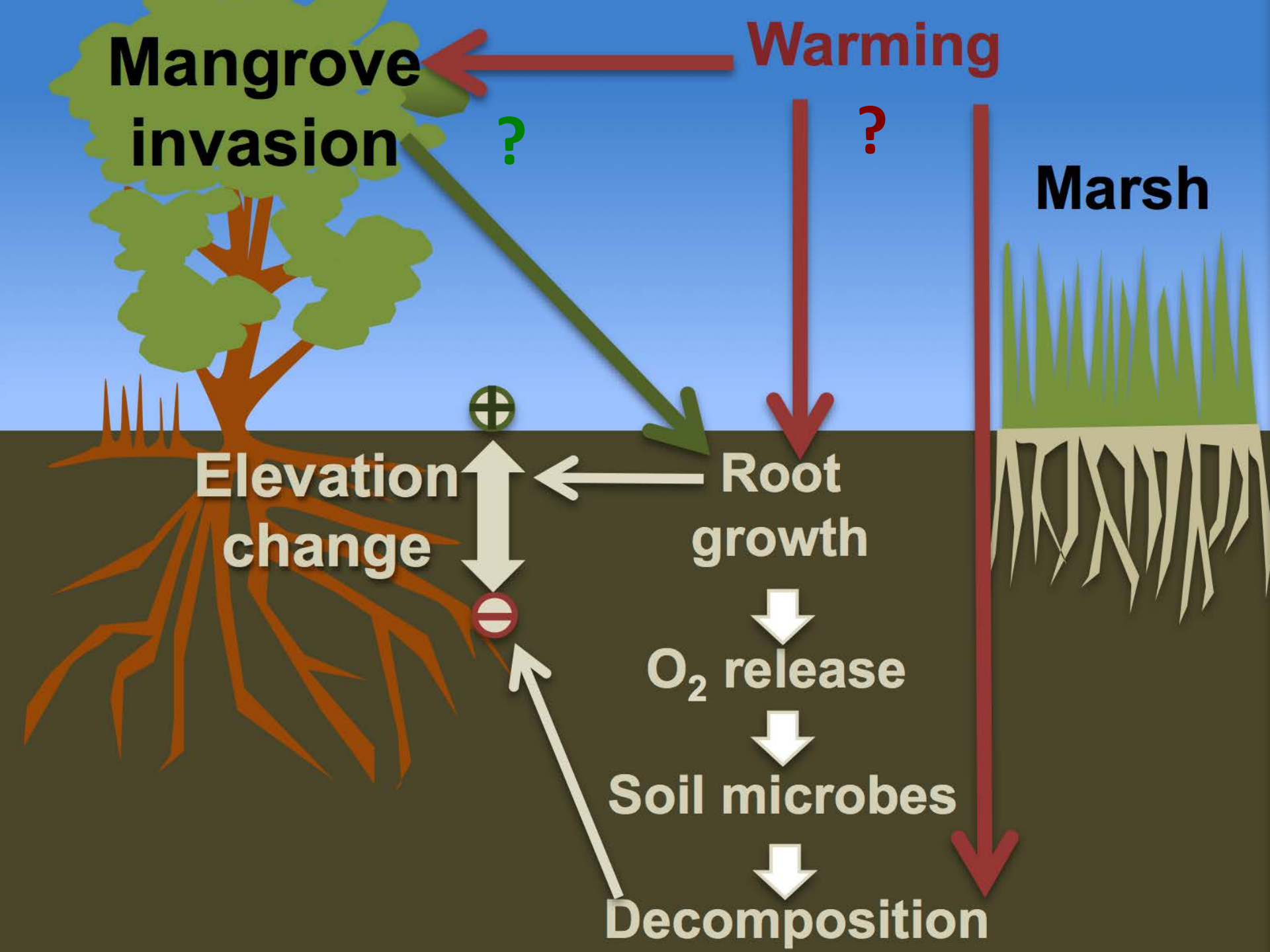
Warming facilitates mangrove encroachment and alters belowground processes

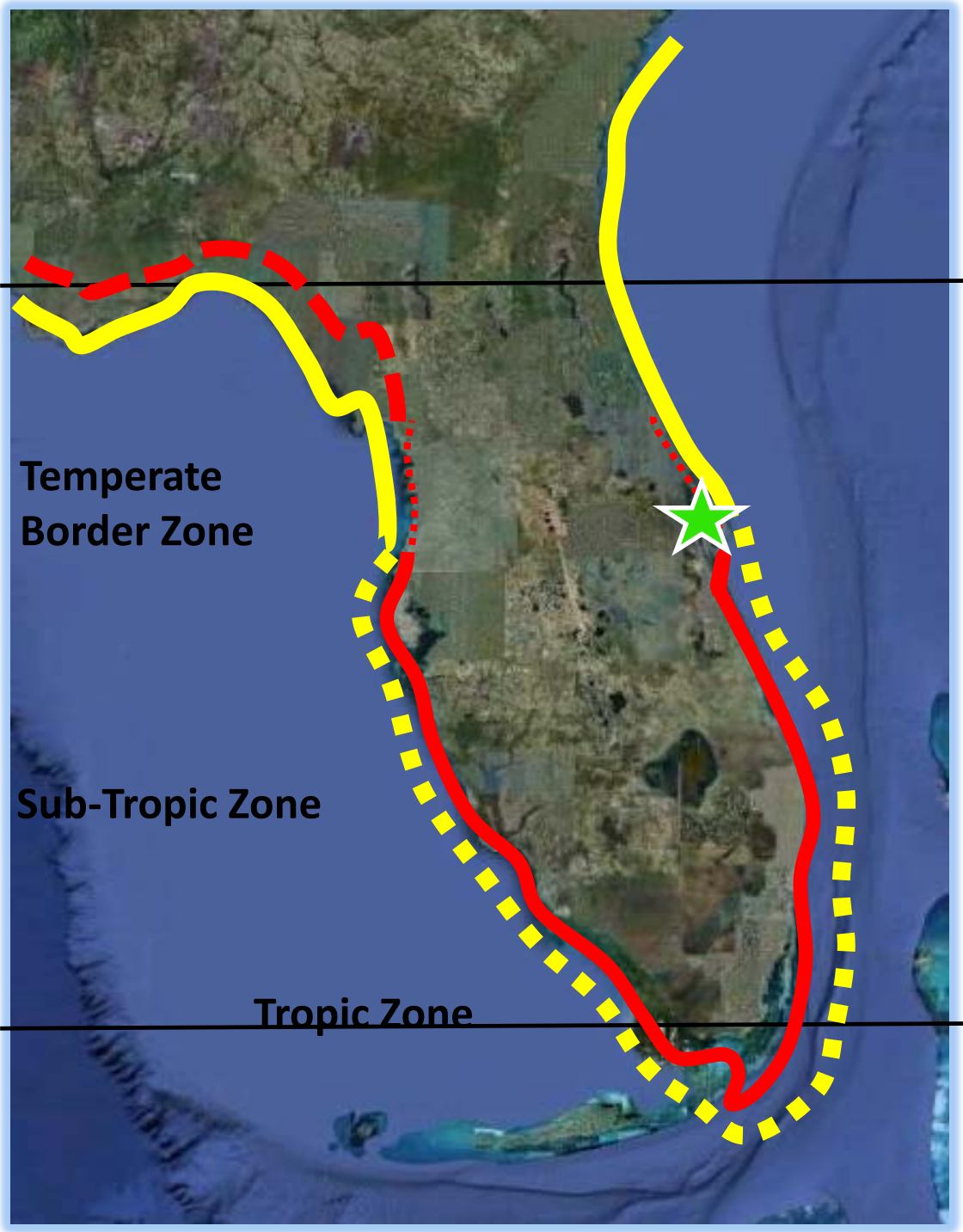
Samantha Chapman, Glenn Coldren, Chelsea Barreto, Ember Morrissey, Heather Tran, Candy Feller

Acknowledgements


Wetfeet project, GTMNERR

Candy Feller, SERC Chapman/Langley Lab Groups at Villanova
Cheryl Doughty, UCLA Staff at Merritt Island Nat'l Wildlife Refuge
Caitlin Dittmeier Staff at Kennedy Space Center,
Brendan Kelly especially Lynne Phillips and Carlton Hall
Adam Langley Matt Hayes, Villanova
Ron Schaub, NASA Lorae' Simpson-UF
NASA grants #s-NNX11AO94G, NNX12AF55G
NSF grant #-DEB1655659


Mangrove invasion
?
Warming
?
Marsh
Elevation change
Root growth
O_2 release
Soil microbes
Decomposition



Species Distribution Overlap

Mangrove Species
- Dominant
- Patchy

Salt Marsh Species
- Dominant
- Patchy

★ Our sites at Kennedy Space Center

First Warming Study

Mangrove Seedlings & Salt Marsh

Response to Warming

Mangrove Seedlings (*Avicennia*)

Minimal effects but increased leaf production

Salt marsh (*Distichlis*)

Strong positive effect but only in Summer

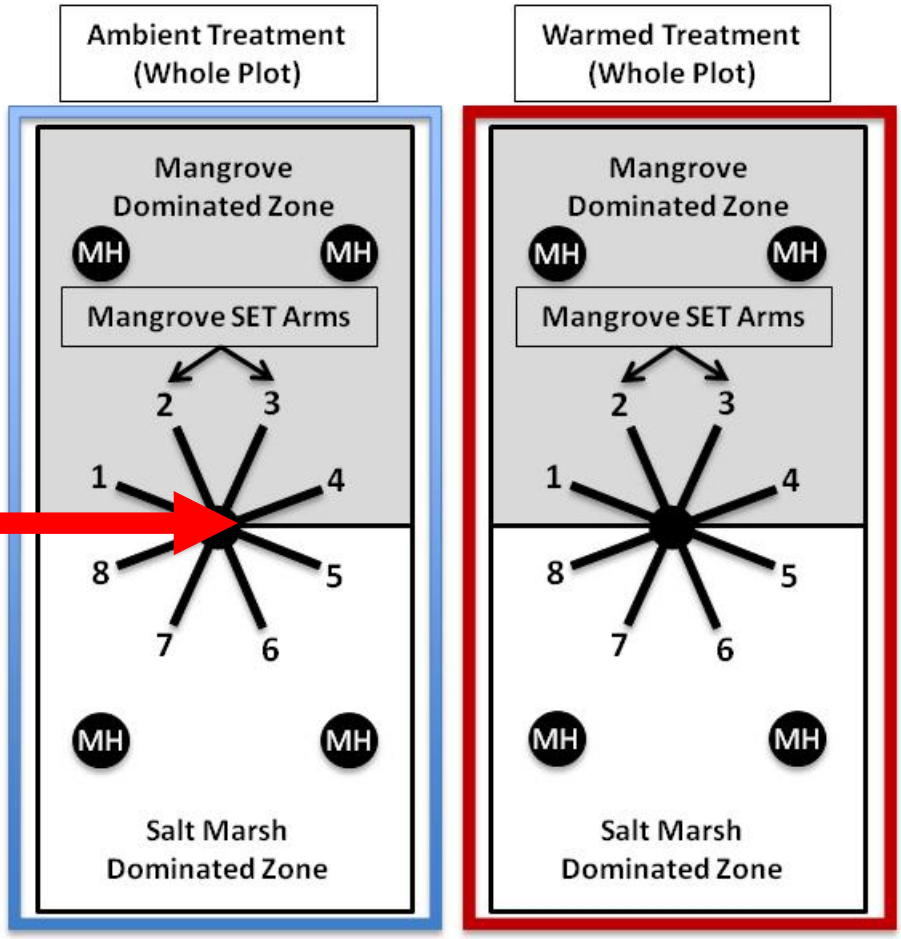
Coldren et al. 2016

Second Warming Study

Larger mangroves & Salt Marsh (with rSET)

- Chambers 2.5m x 6m x 2.5m (polycarbonate panels)
- 5cm gap between base of frame and soil surface
- Two vegetation types in each plot (n=3)
  - *Distichlis spicata, Laguncularia racemosa*
- Deployed in summer 2014, warming for 2 years.
- Passive warming- Average temp. difference 2°C, measured every 30 minutes. (also NASA weather network)

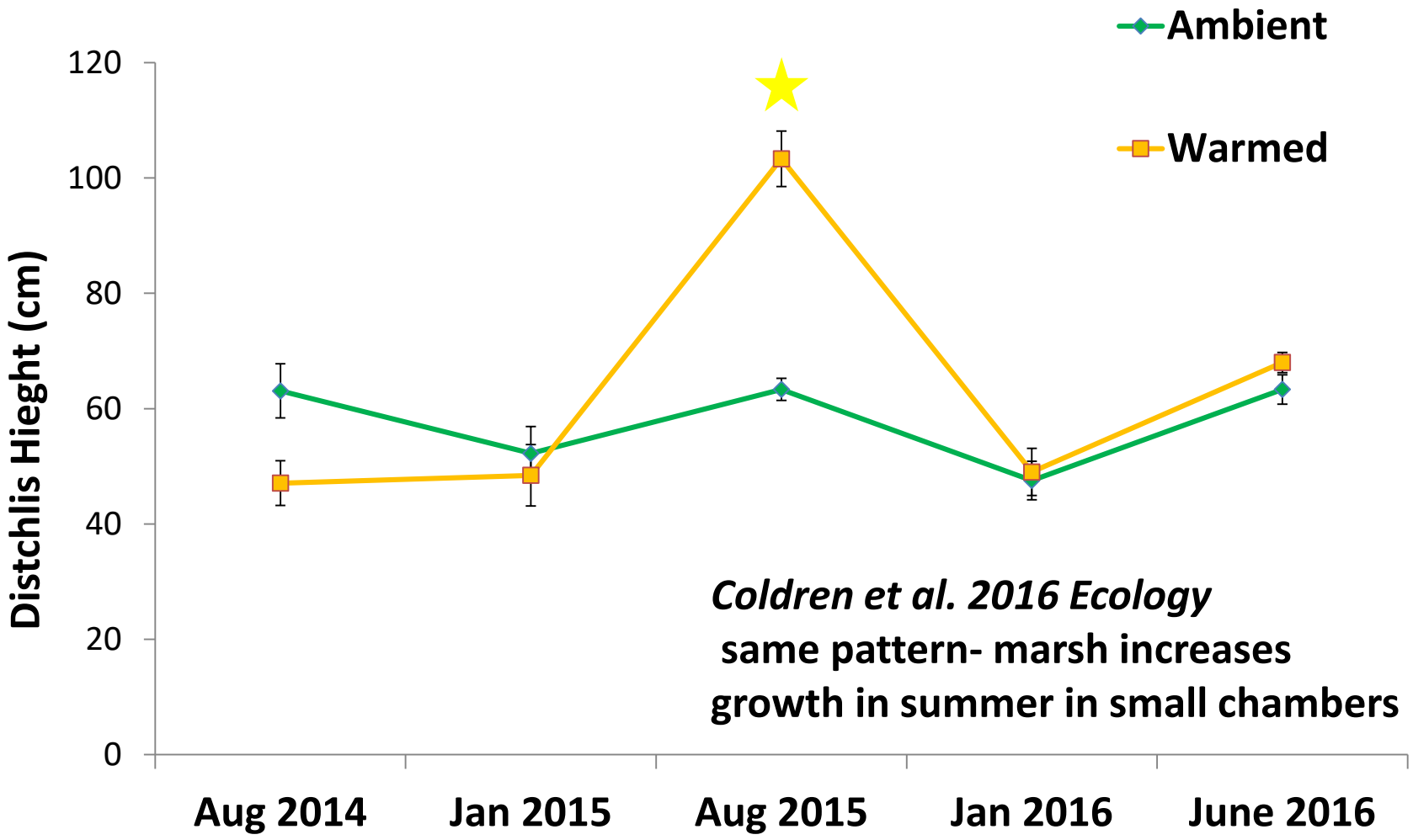
Warming Plot and Surface Elevation Table design (rSET)



rSET- 4 positions per plot

MH- marker horizons in this microtidal system

Salt marsh grew more in summer due to warming



Mangrove leaves grow more with warming

Ambient Warmed

Leaf Abundance

P<0.1036

Leaf Pairs Present/ Branch

100
80
60
40
20
0

Ambient Warmed

Leaf Size

P<0.0582

Leaf Area (mm^2)

2000
1800
1600
1400
1200
1000

Ambient Warmed

Mangrove height and canopy volume increased with warming

Ambient Warmed

Height

P<0.0479

Height Change (cm)

80
70
60
50
40
30
20
10
0

Ambient Warmed

Canopy Volume

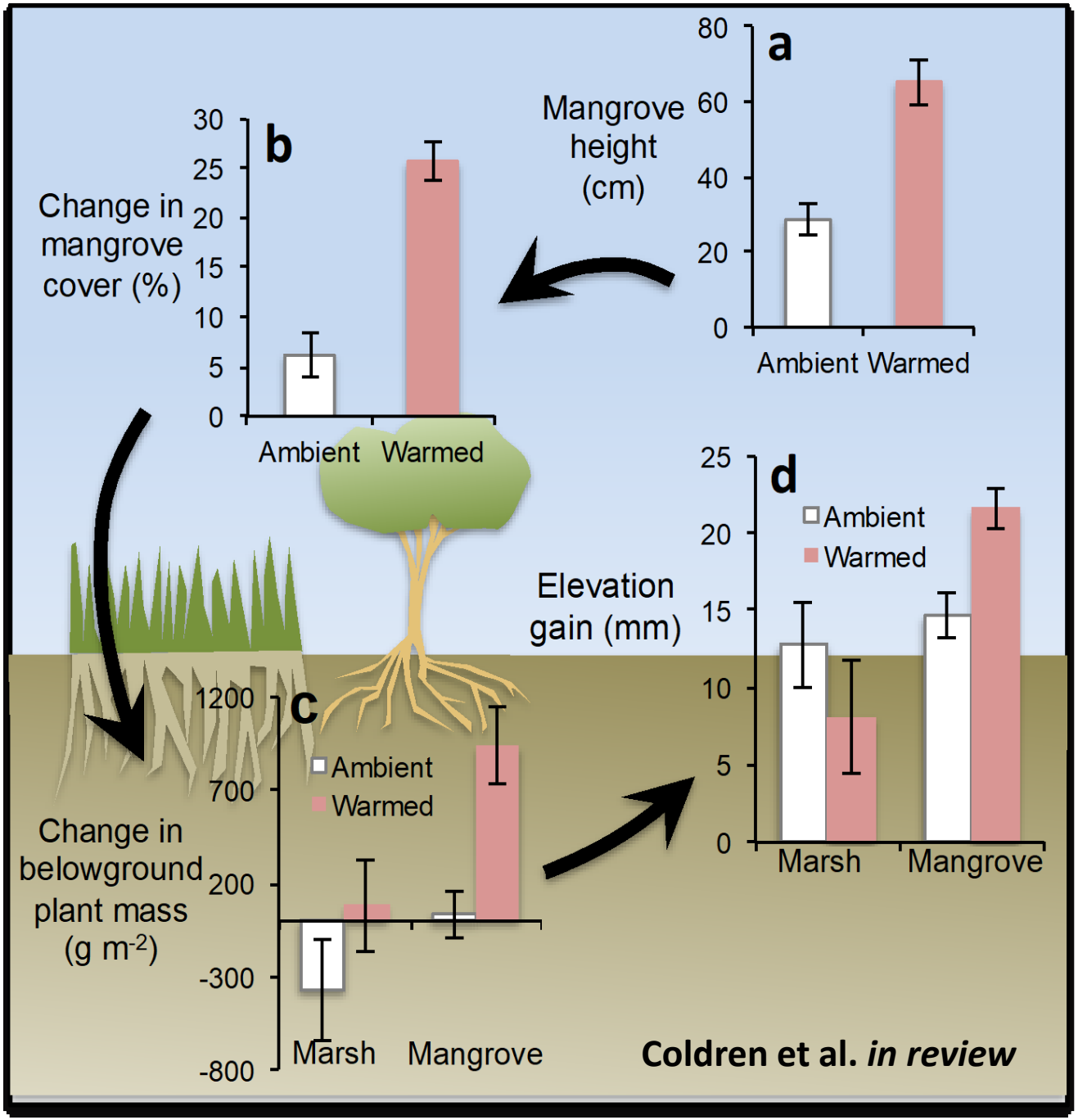
P<0.0400

Canopy Volume Change (m^3)

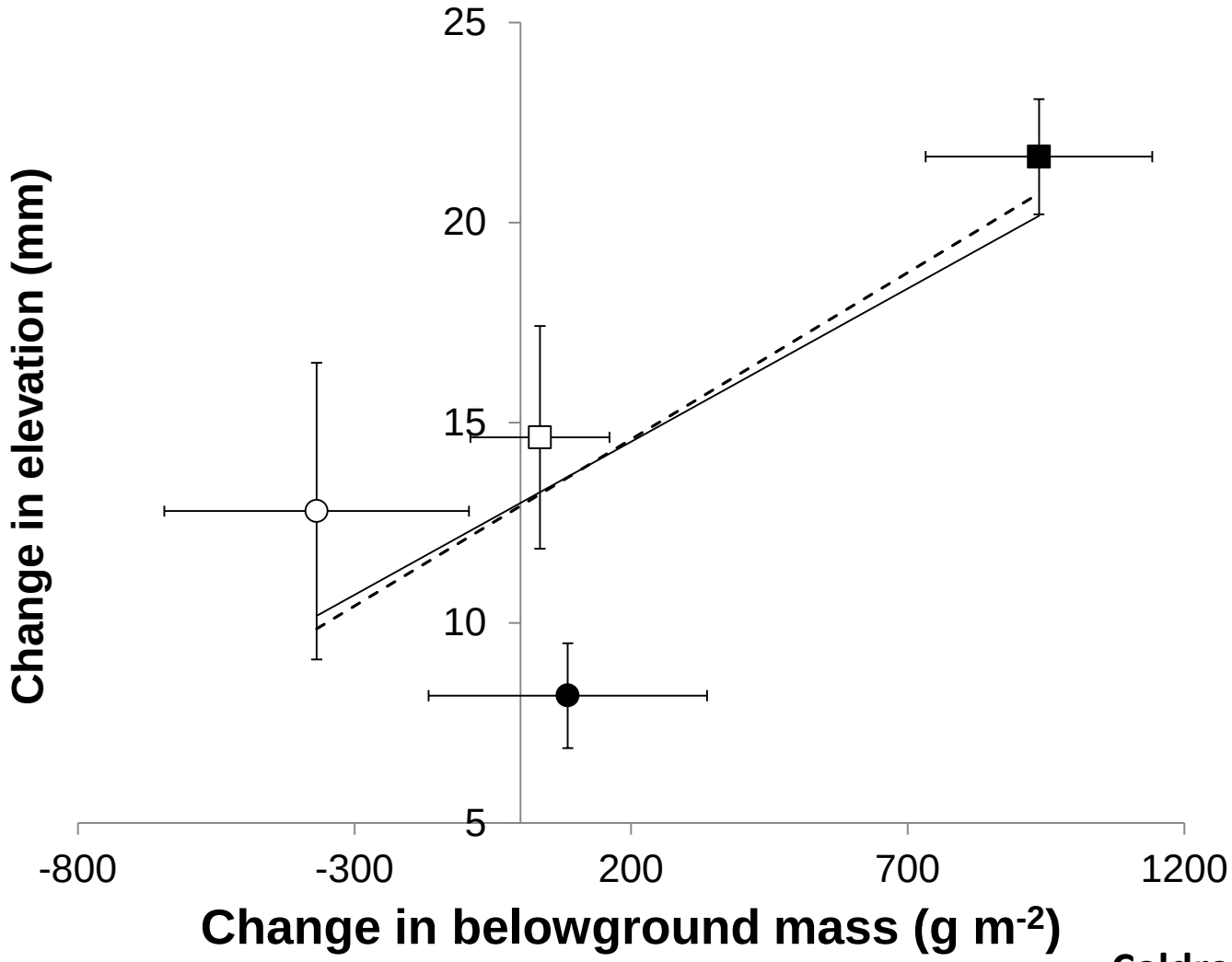
16
14
12
10
8
6
4
2
0

Ambient Warmed

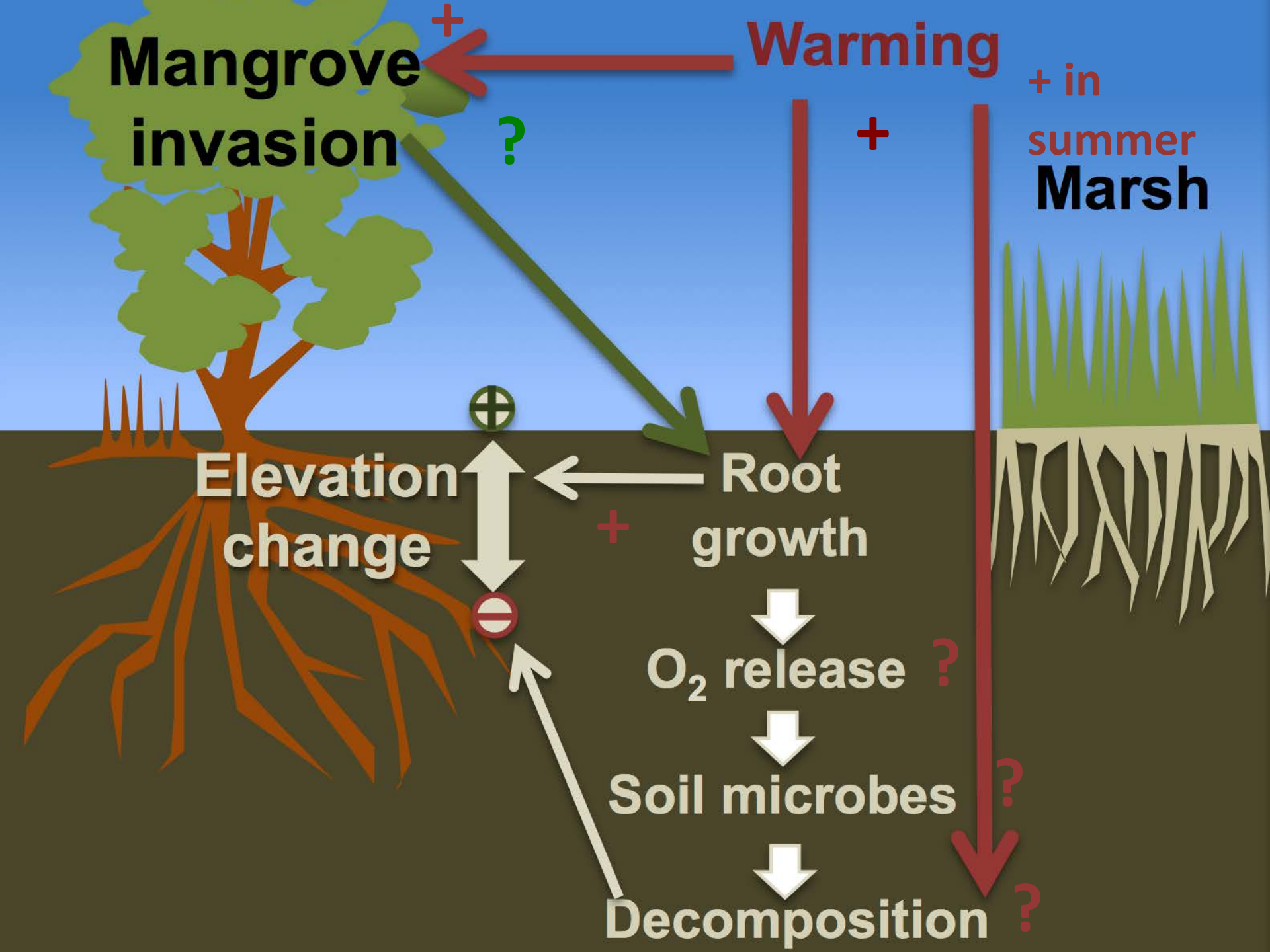
Putting it all together



Change in roots was correlated with changes in elevation



Coldren et al. *in review*


Mangrove invasion
+
Warming
+ in summer
Marsh
?
+
Elevation change
Root growth
+
O_2 release
?
Soil microbes
?
Decomposition
?

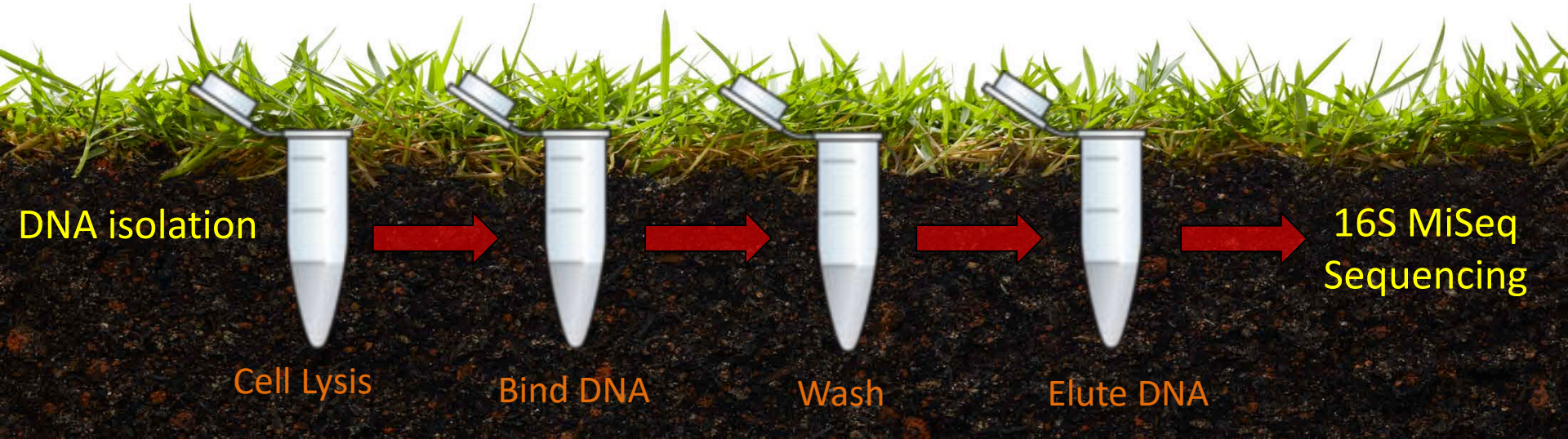
Soil, Microbial Community Analyses, and SIR Assay

Microbial Sample Coring

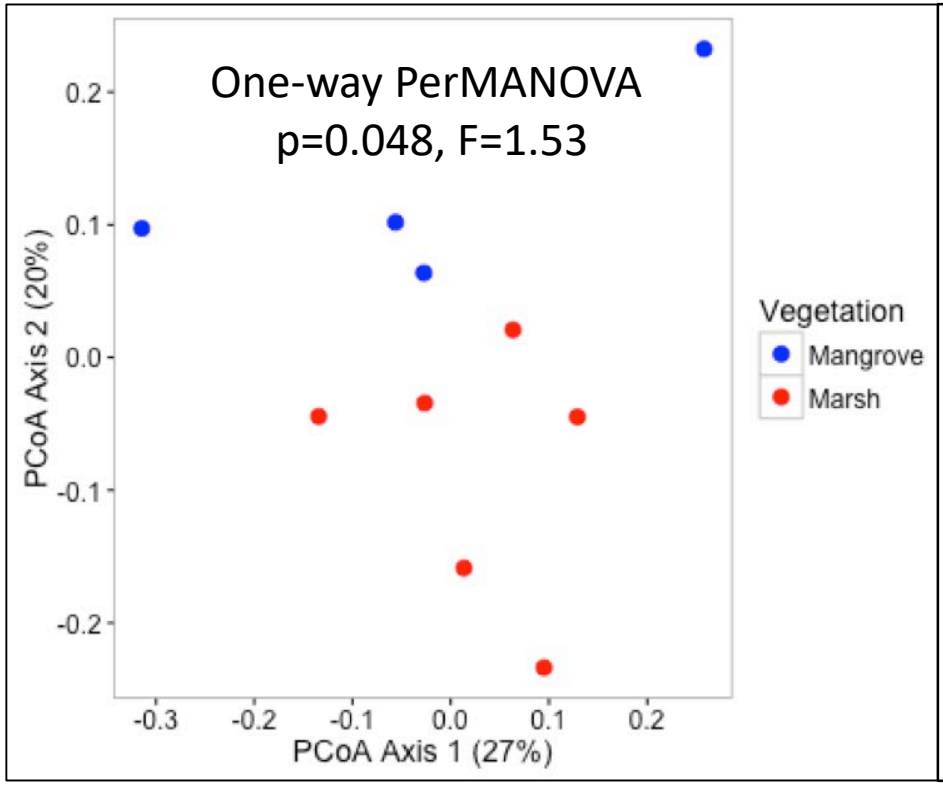
- Cores to 60cm in mangrove-dominant vs. marsh dominant plots in March 2016
- Roots sorted into fine and coarse
- Subsampled at 5cm (in organic layer) and froze immediately

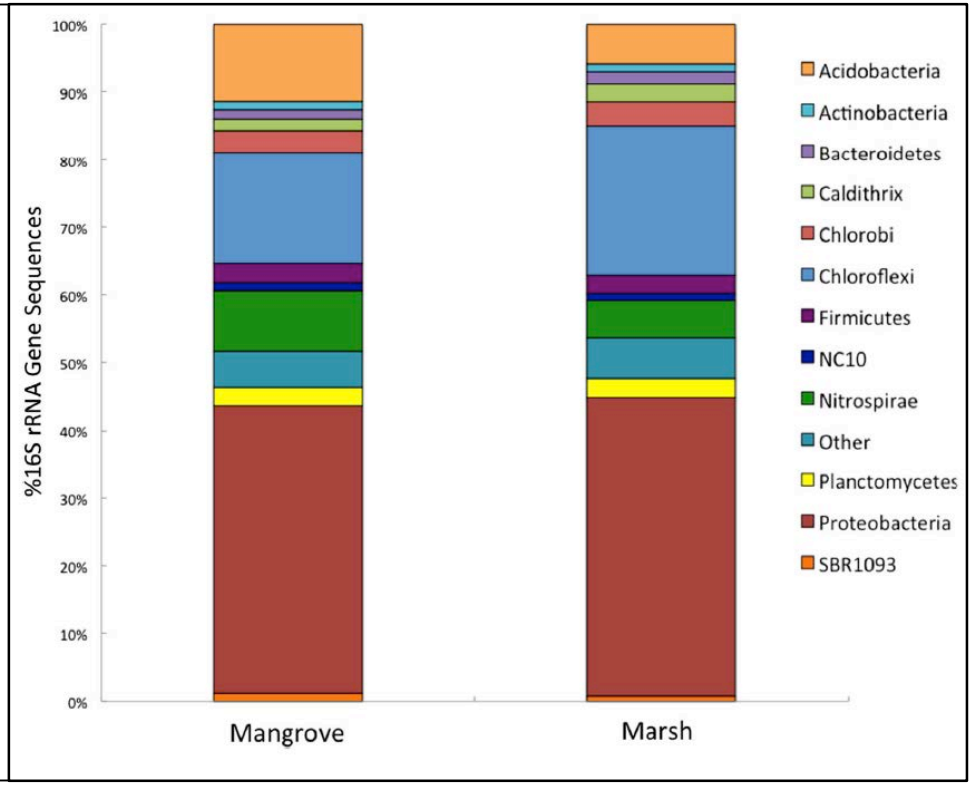
Substrate Induced Respiration (SIR) Assay

- Measured potential ability of mangrove & marsh soil communities in warming vs. ambient plots to process labile C substrates
- Added yeast to incubations



Microbial community structure is different in mangrove vs. marsh soils

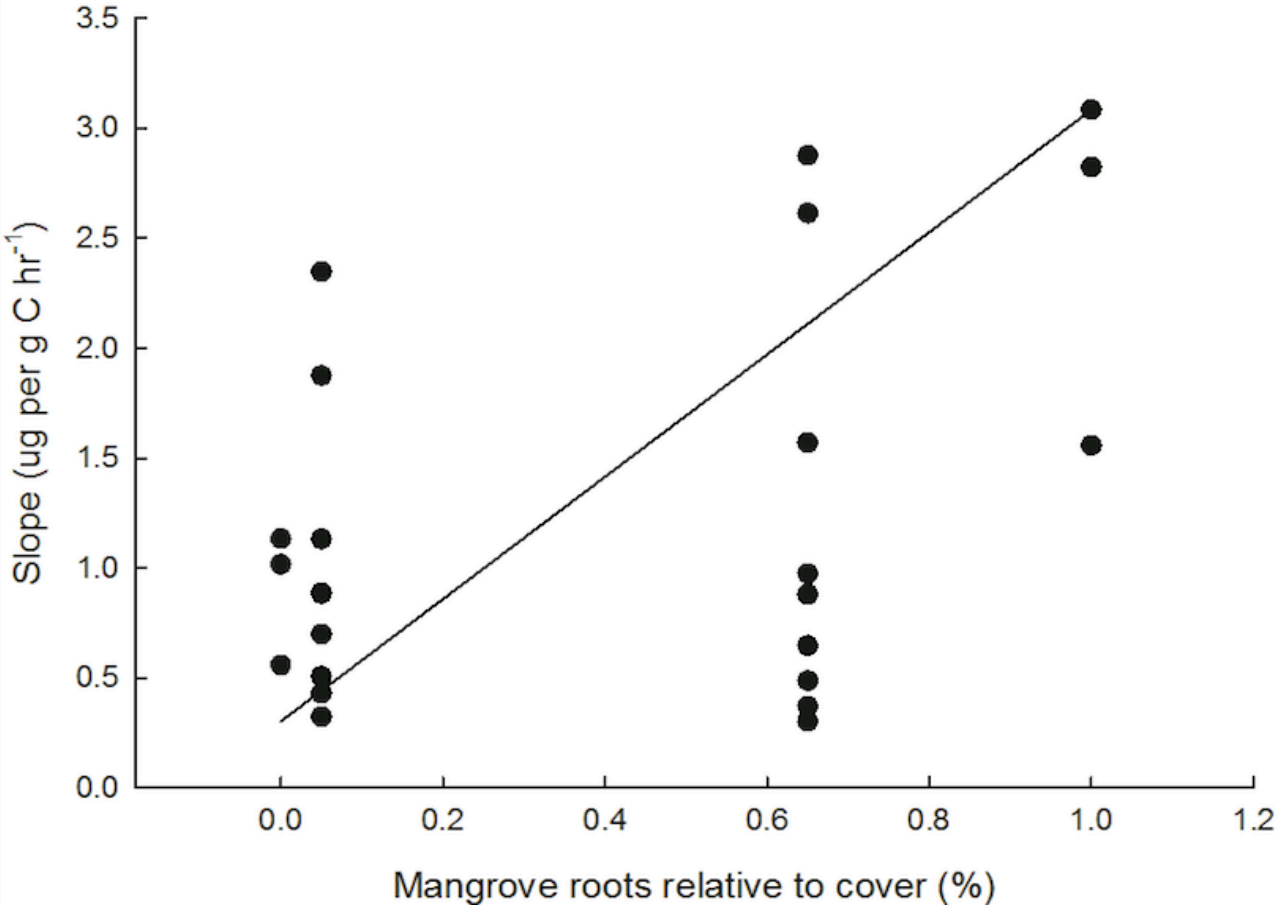




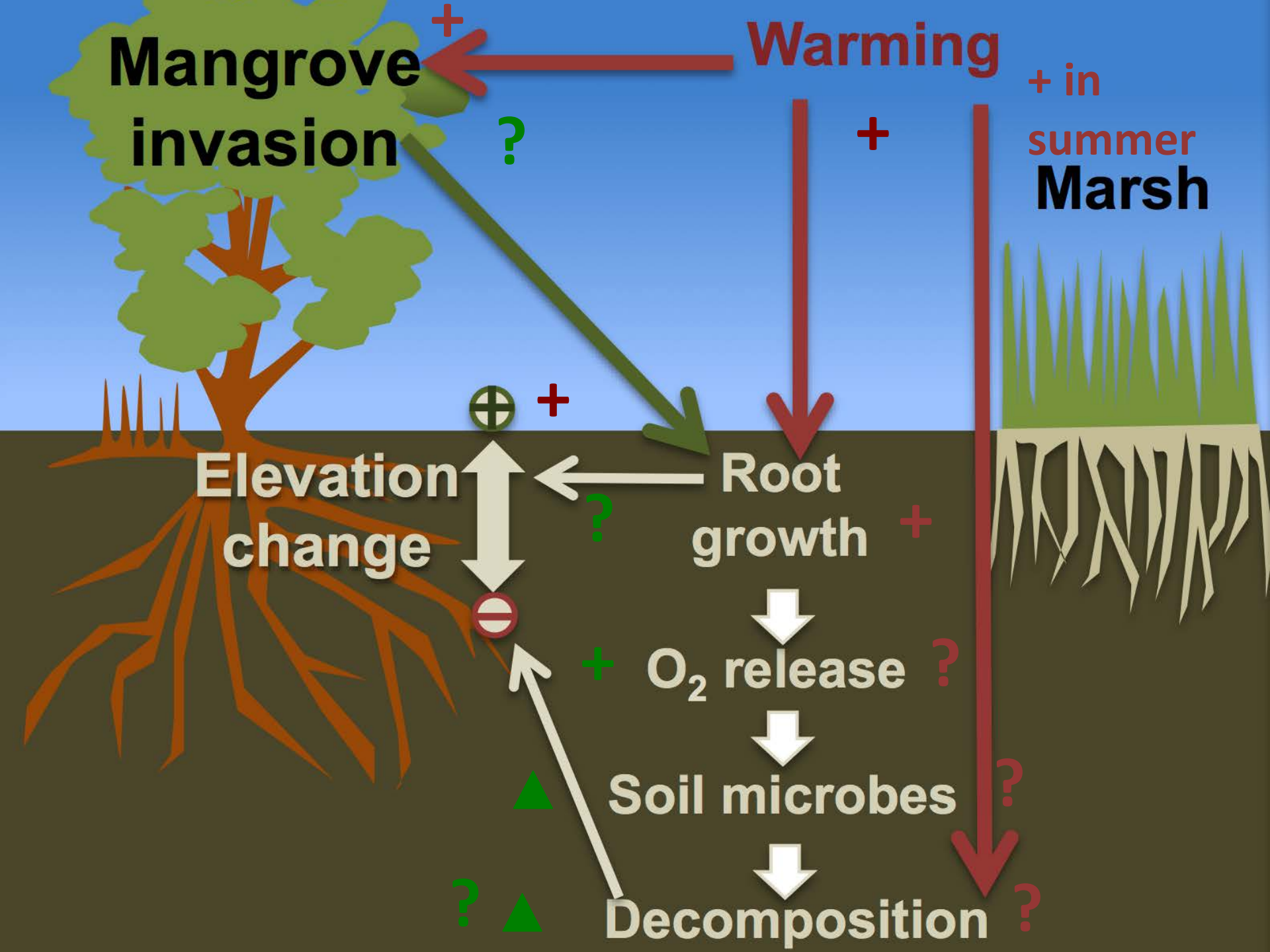
Indicator species analyses also showed that multiple aerobic taxa are indicators of mangrove soils and anaerobic taxa indicate marsh soils.

Barreto et al. 2018

Labile substrate usage is higher in mangrove dominated soils

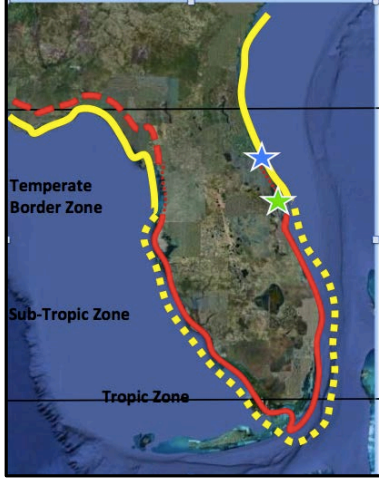


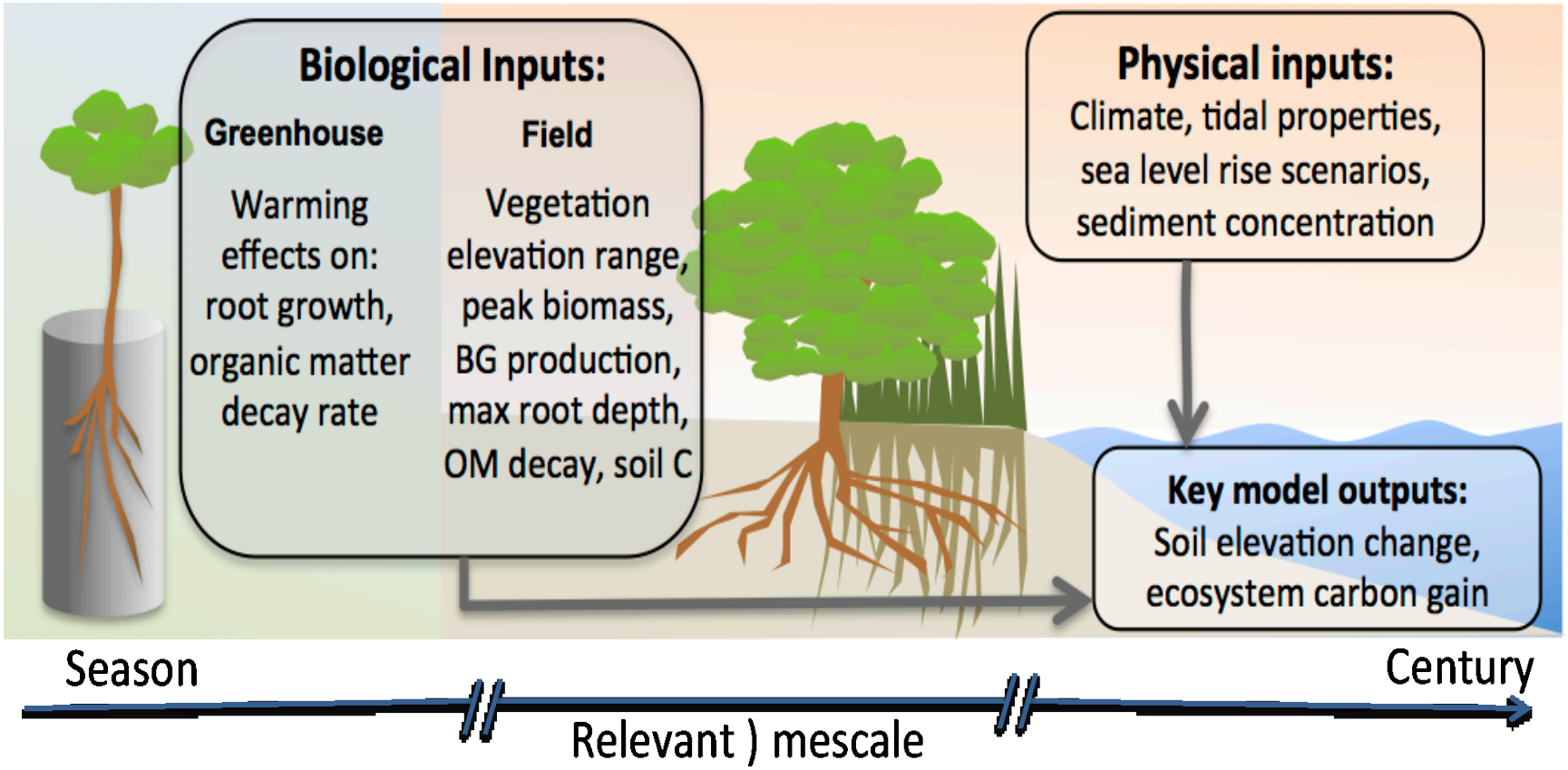
Barreto et al. 2018


Mangrove invasion
+
Warming
+ in summer
Marsh
?
+
+
Elevation change
?
Root growth
+
+
O_2 release
?
Soil microbes
?
?
Decomposition
?

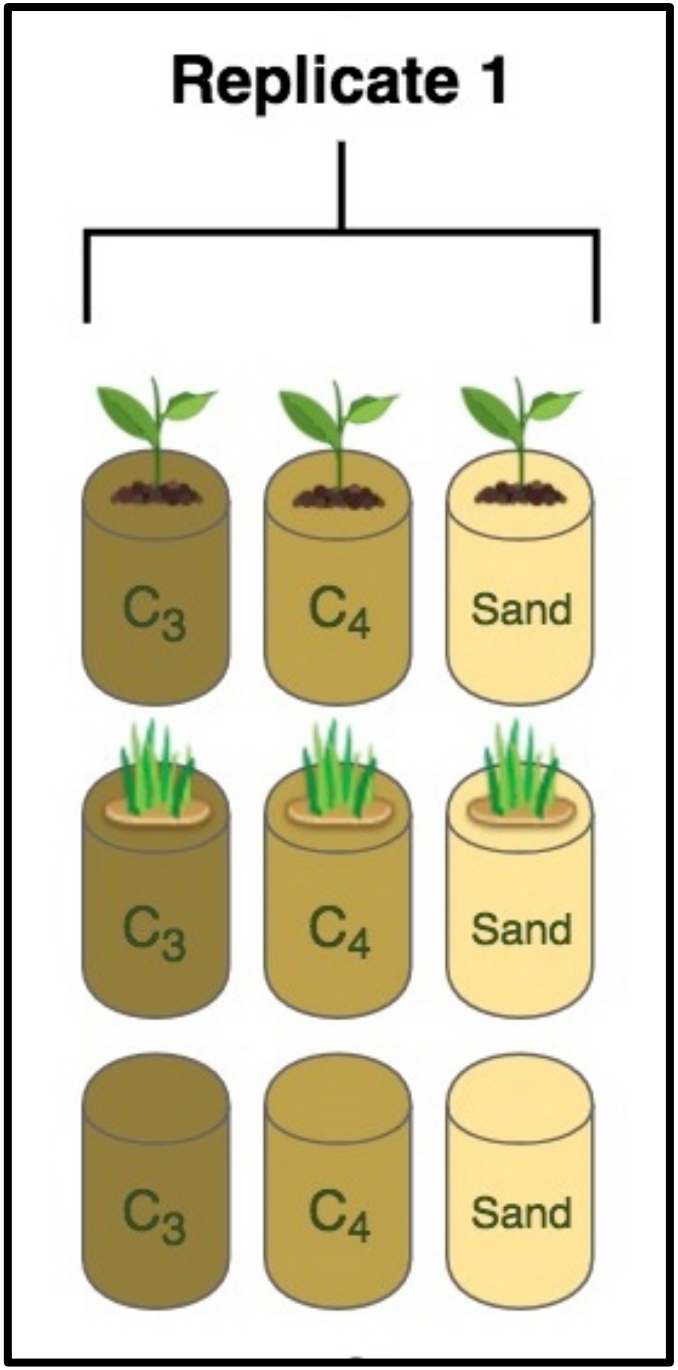
Wetfeet project

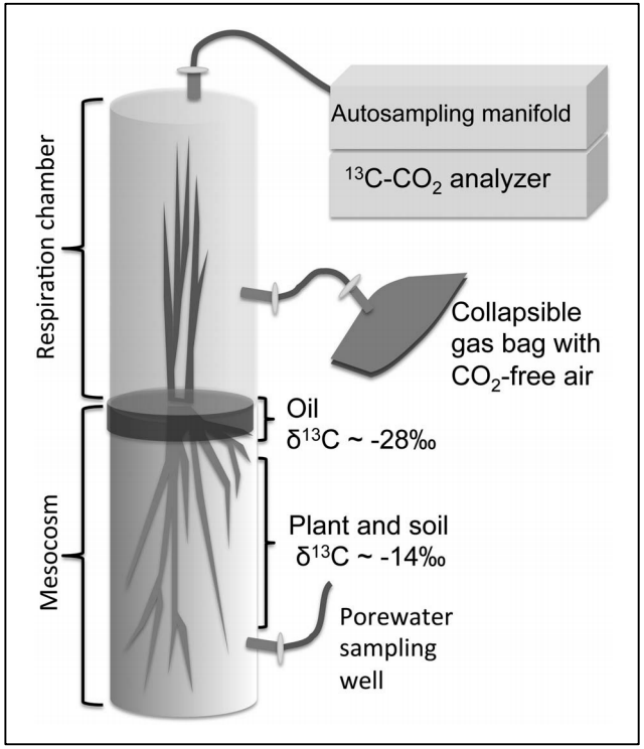
With Candy Feller (SERC), Mark Hester (ULL), Jim Morris (USC), Nikki Dix (GTMNERR), Adam Langley (Villanova), and Matt Hayes (Villanova)

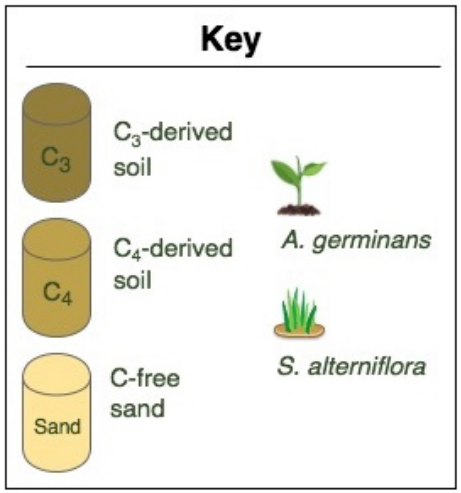




Determining the influence of mangroves on soil organic matter processing via ^{13}C partitioning mesocosms







10 replicates

We have identified and collected *Spartina* and mangrove soils
that have enough separation in ^{13}C values