Subsidence as a Function of Salinity Intrusion and Peat Collapse in a Karst Environment

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sfwmd.gov

We ask two questions:

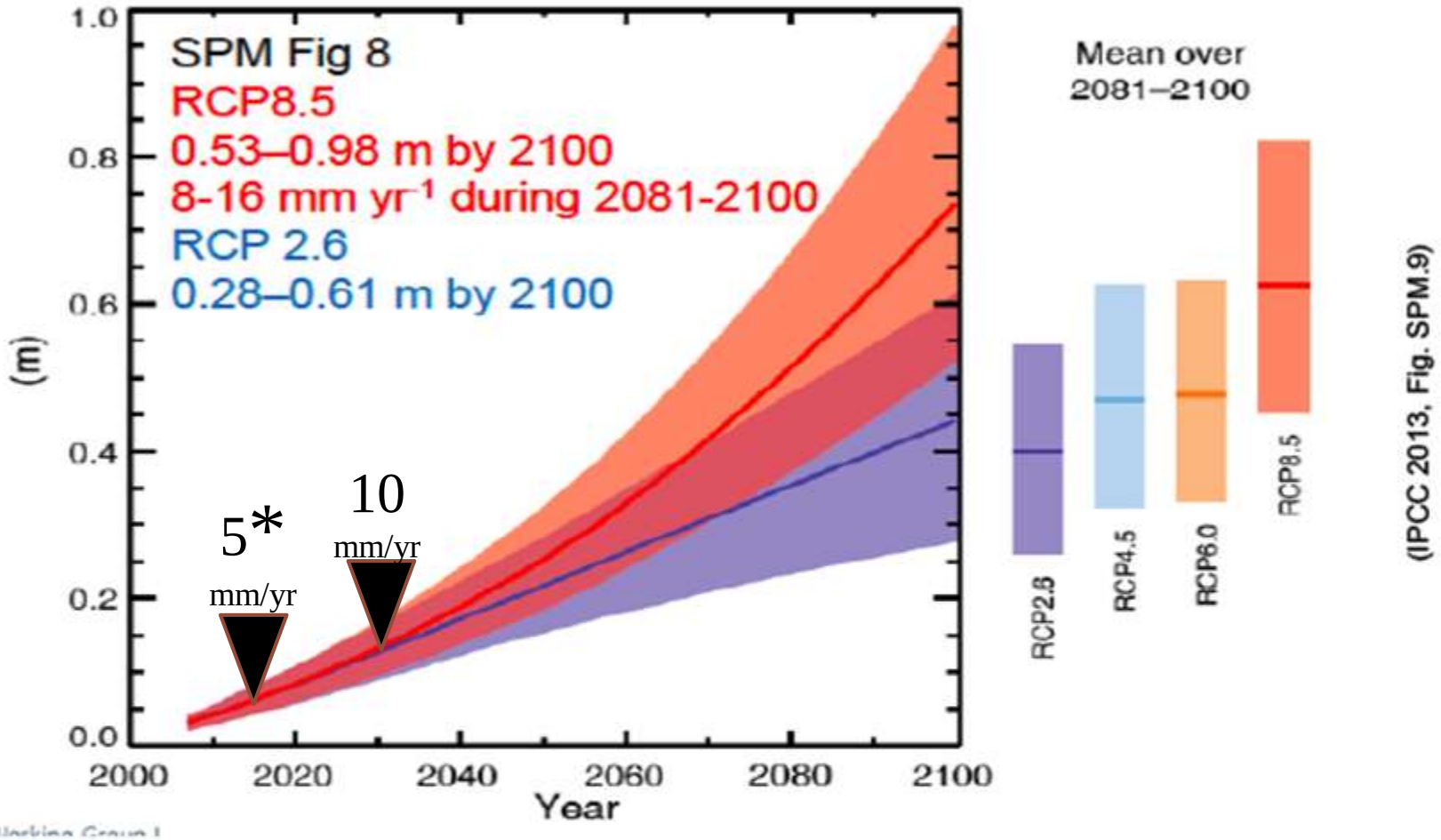
1. ***What are the physical, chemical, and biological changes associated with increasing salinity in oligohaline sawgrass peat communities?***

2. ***Are the coastal mangrove systems of Florida Bay keeping up with sea level rise?***

We answer with:

1. ***Results from a Florida Sea Grant project: Salt dosing chambers in a brackish sawgrass marsh.***

2. ***A review of the SFWMD's Florida Bay, Sediment Elevation Table (SET) network***

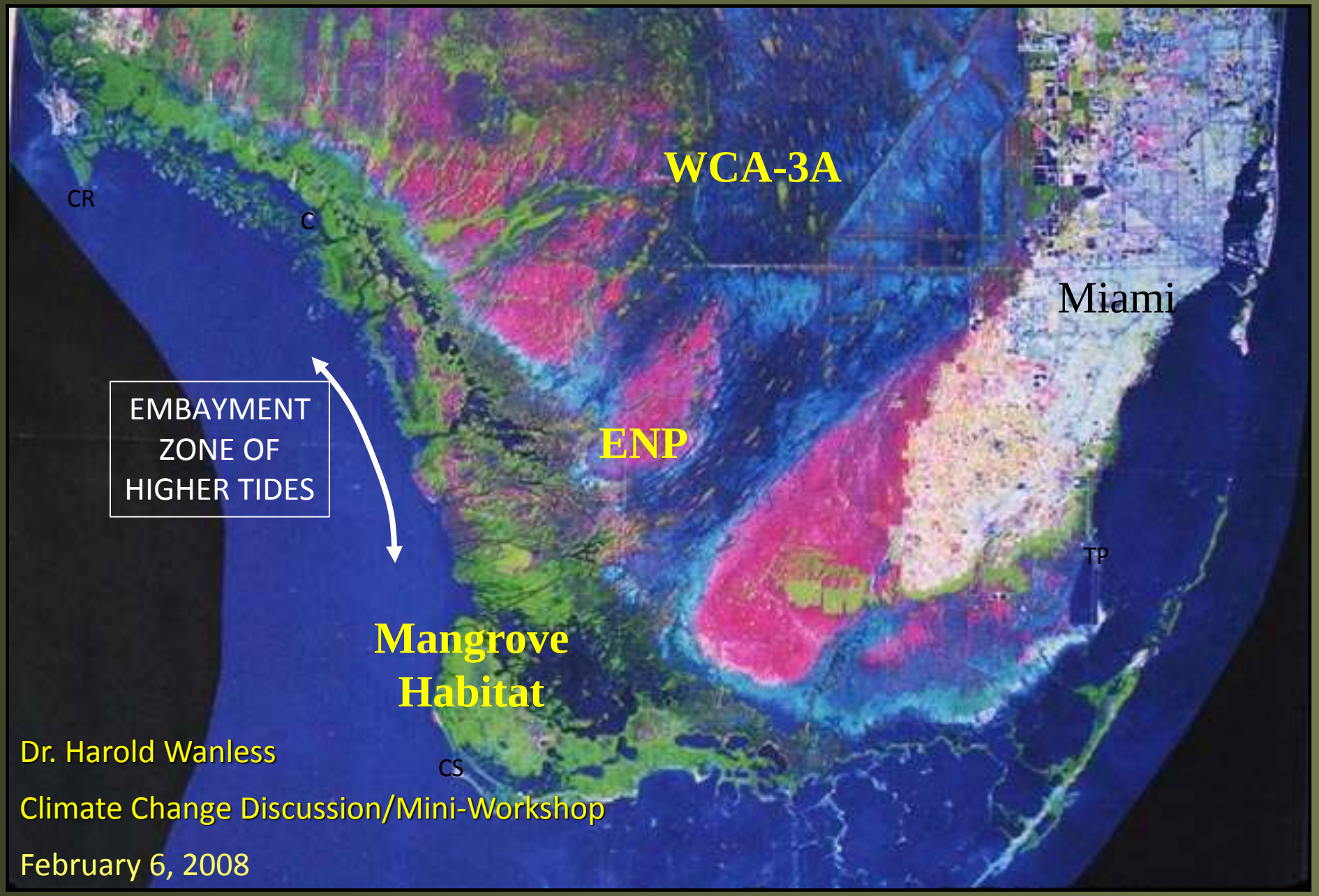


*7 mm/yr : According to Wdowinski, S., R. Bray, B. P. Kirtman, and Z. Wu (2016).

“Peat Collapse” is due to salt inundation.

Dr. Harold R. Wanless, Department of Geological Sciences, University of Miami

South Florida 1995



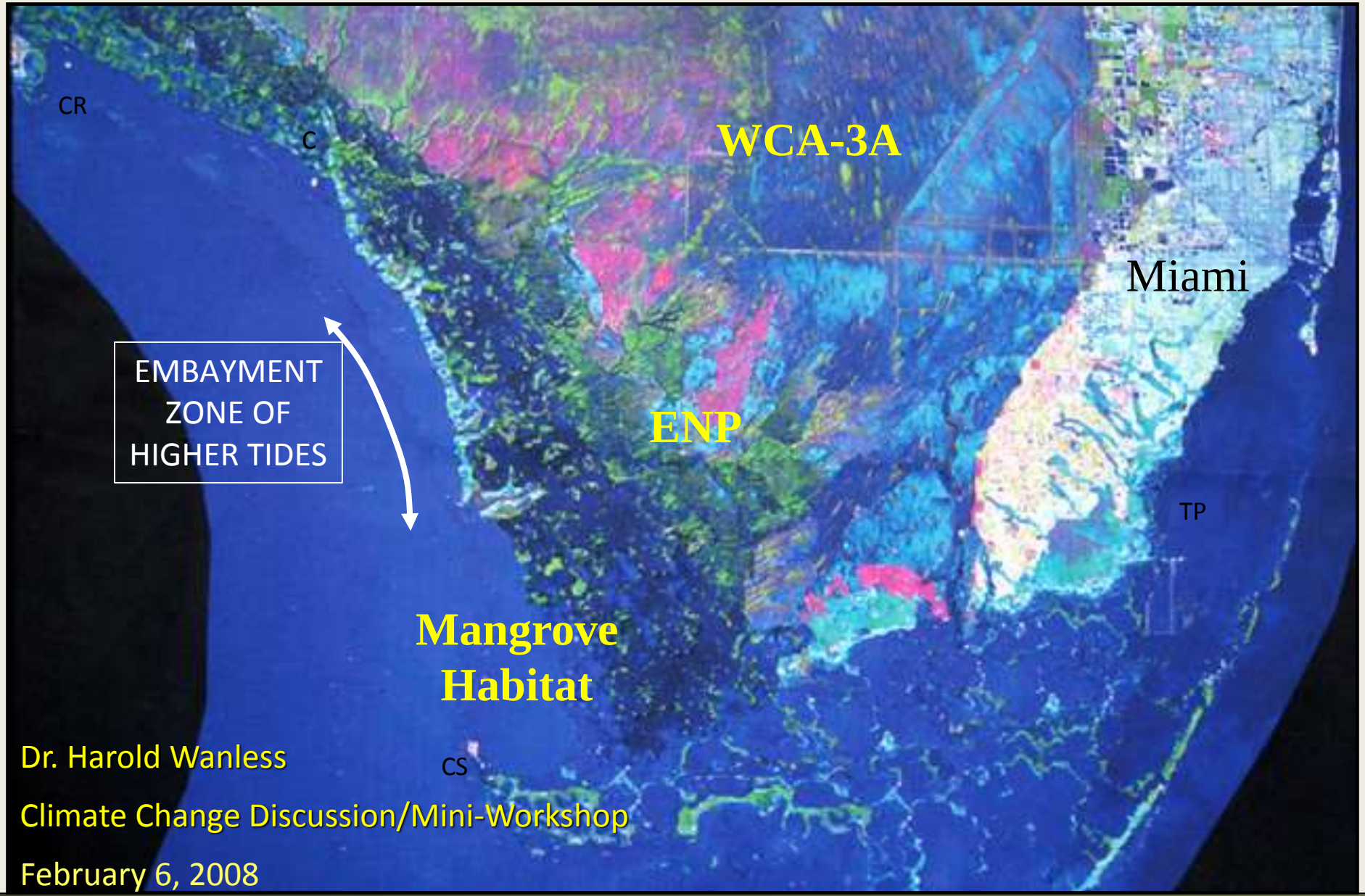
Dr. Harold Wanless

Climate Change Discussion/Mini-Workshop

February 6, 2008

+2 foot rise (mhhw = +4.5' above 1929 MSL)

South Florida 2100



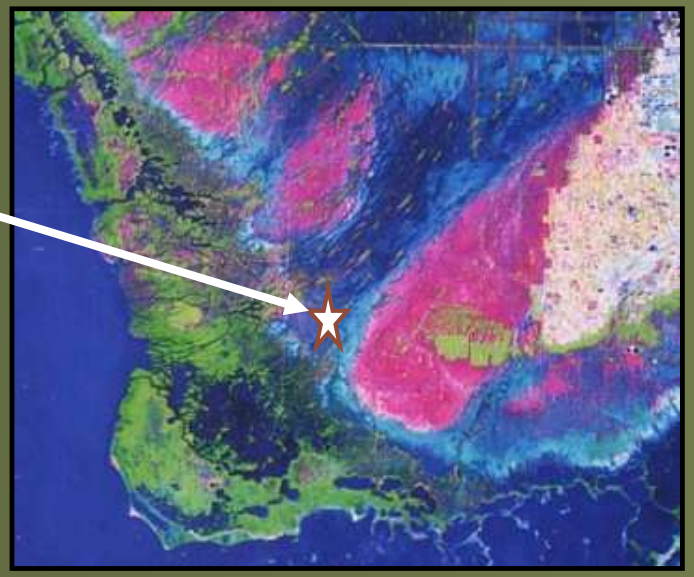
Dr. Harold Wanless

Climate Change Discussion/Mini-Workshop

February 6, 2008

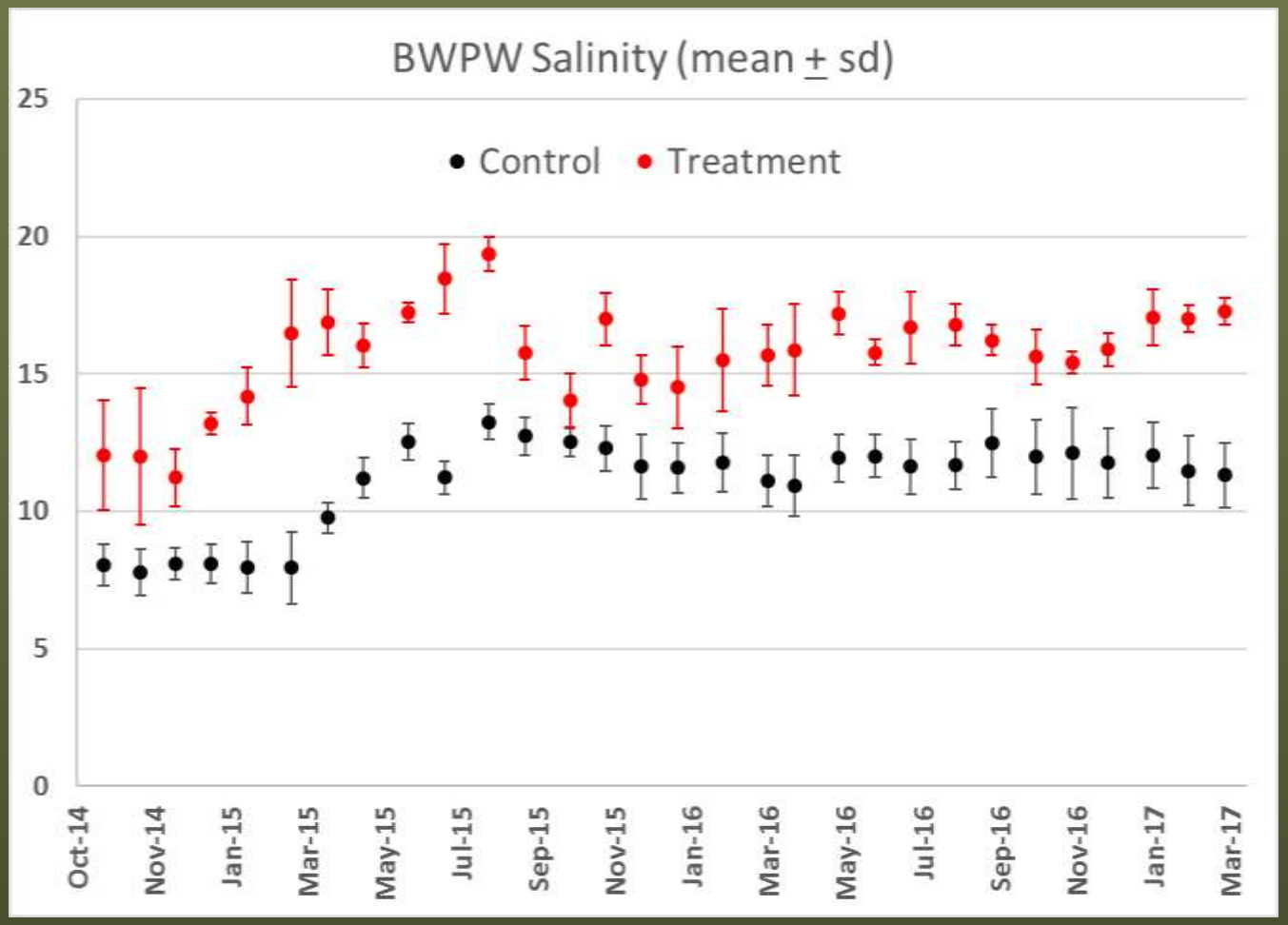
Peat collapse contributes to instability of coastal marshes of the US (Cahoon et al. 2003, Nyman et al. 2006, Voss et al. 2013) and is largely attributed to:

1. changes in microbial processes,
2. increased sulfate reduction,
3. inadequate root production and
4. vegetation damage from tropical storms.



Peat Collapse in Salt Dosing Chambers

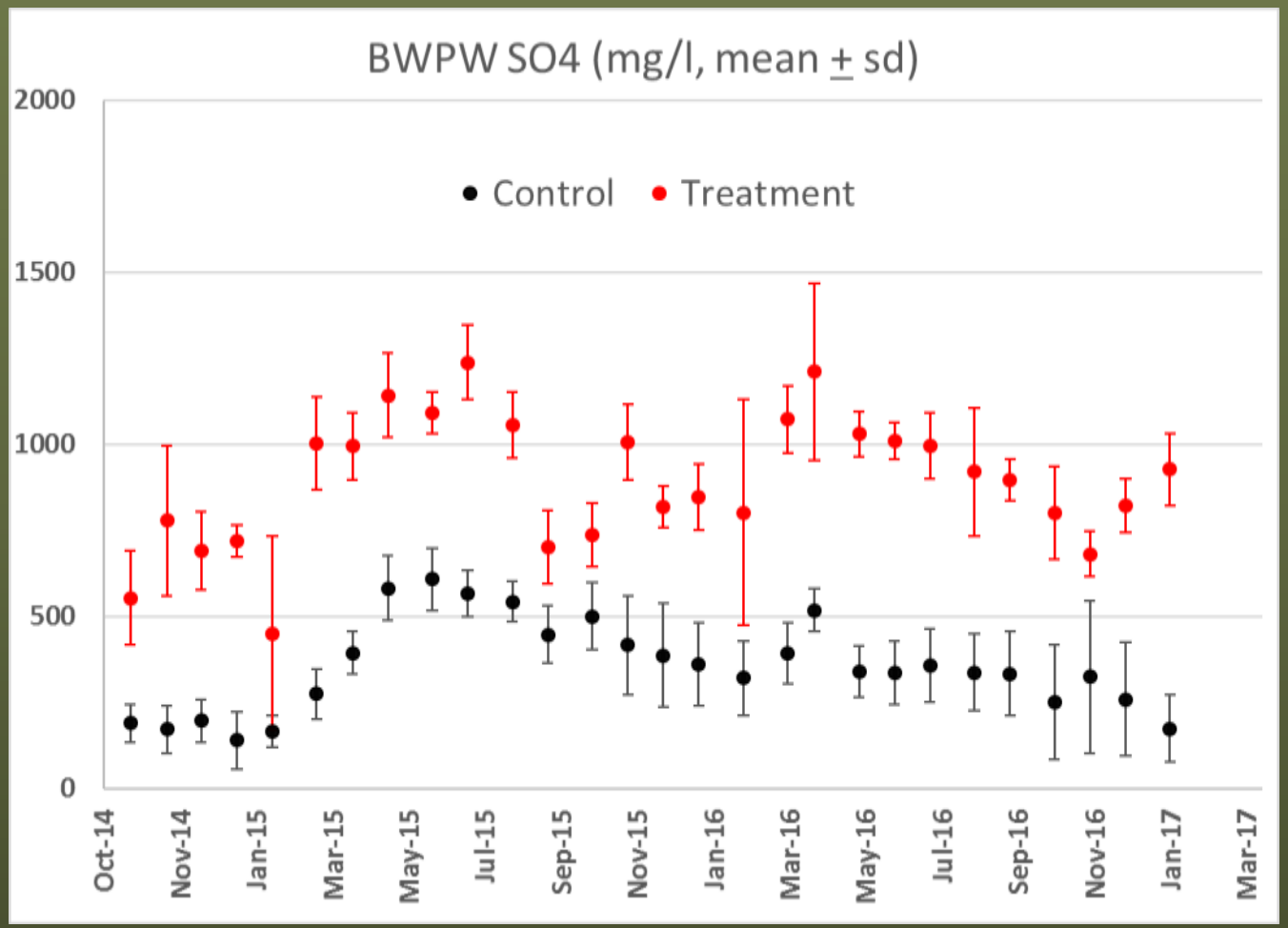
We hypothesize that enhanced salinity (simulating saltwater intrusion) in freshwater and oligohaline peat communities will lead to peat collapse through decreased root turnover and increased C loss from soil and litter.



Porewater Brackish Marsh Salinity (psu) Trend

Red = Treatments

Black = Controls

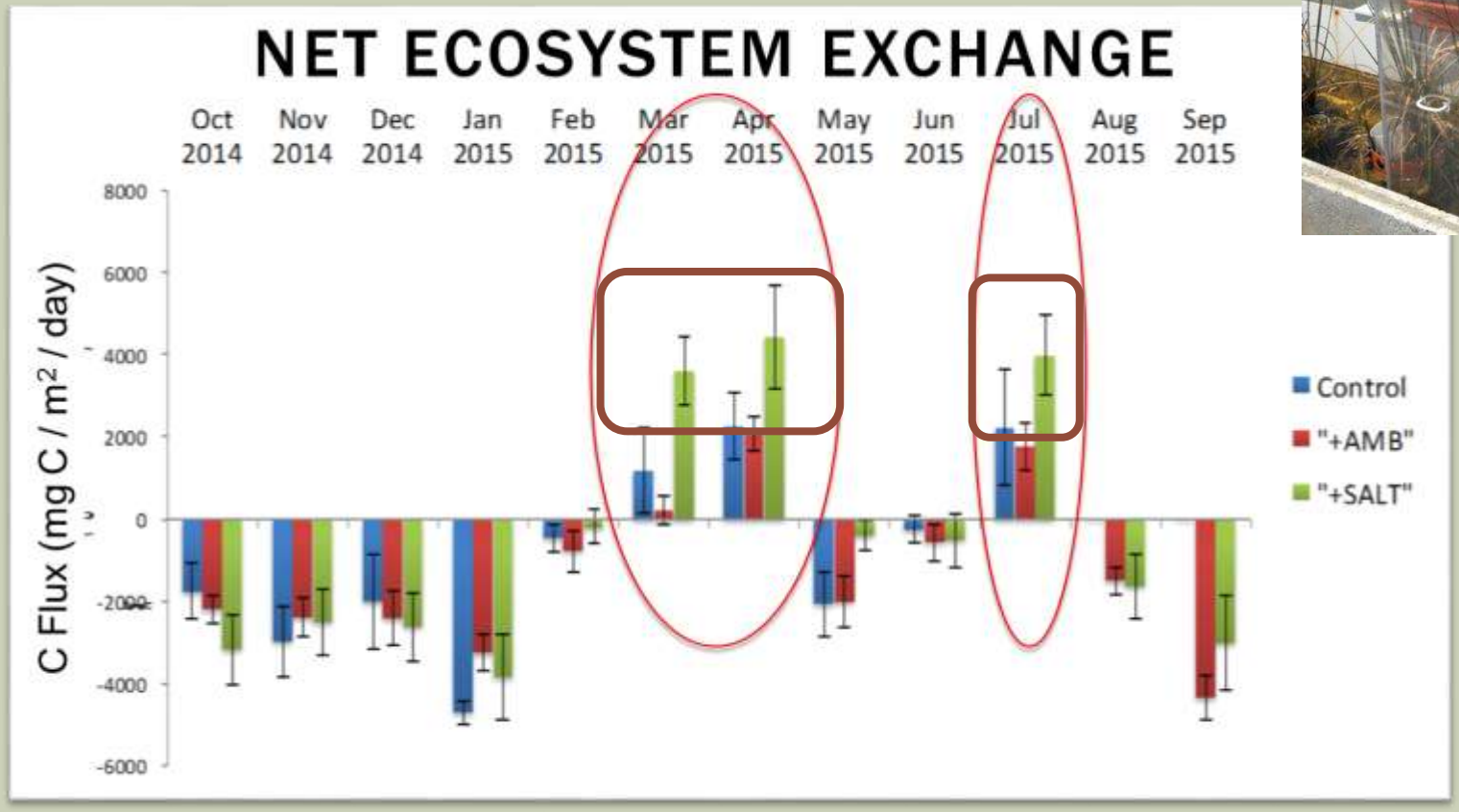


Porewater Brackish Marsh Sulfate (mg/l) Trend

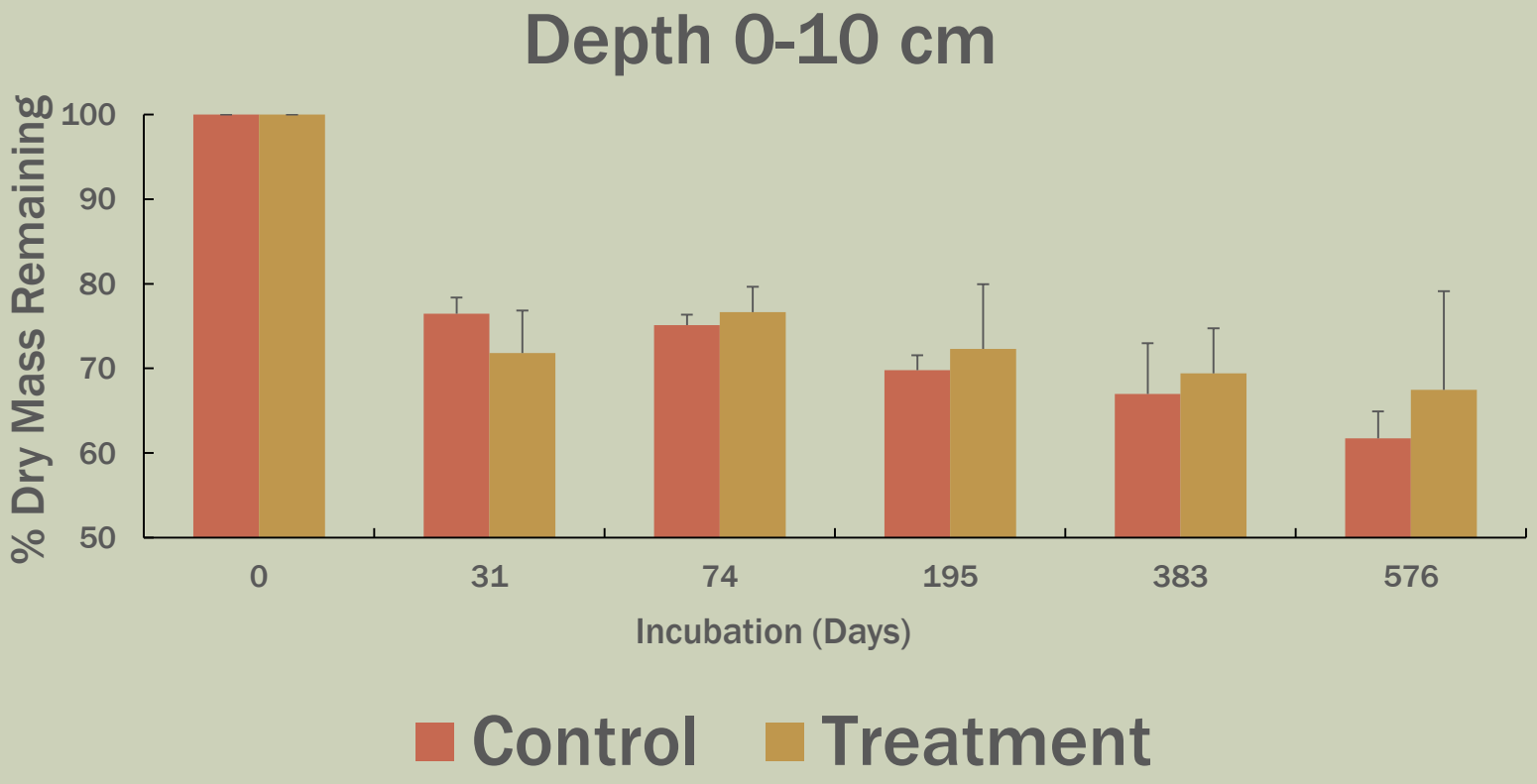
Red = Treatments

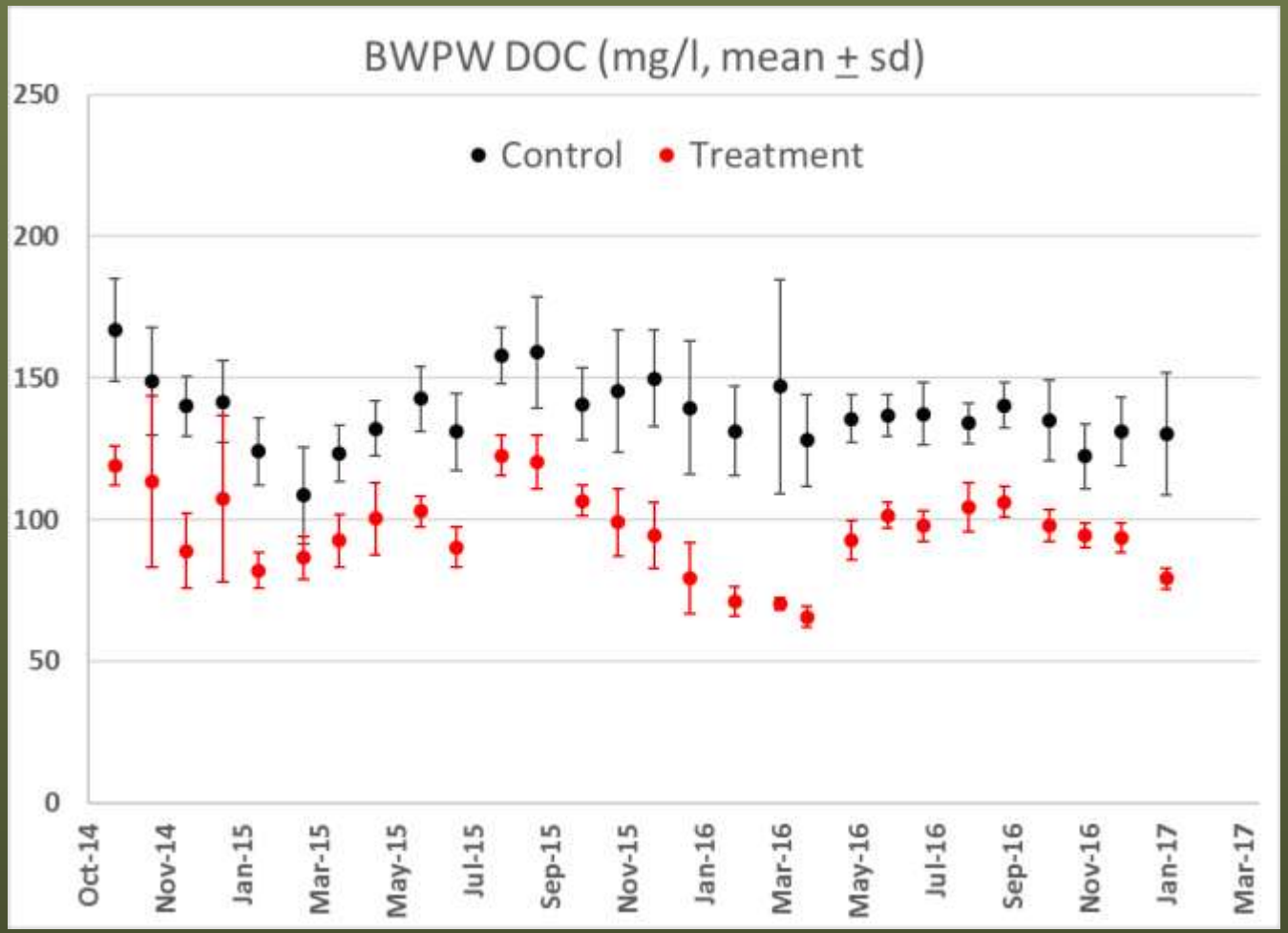
Black = Controls

Carbon Chamber used in the Field Dosing Experiments



BRACKISH MARSH ROOT DECOMPOSITION

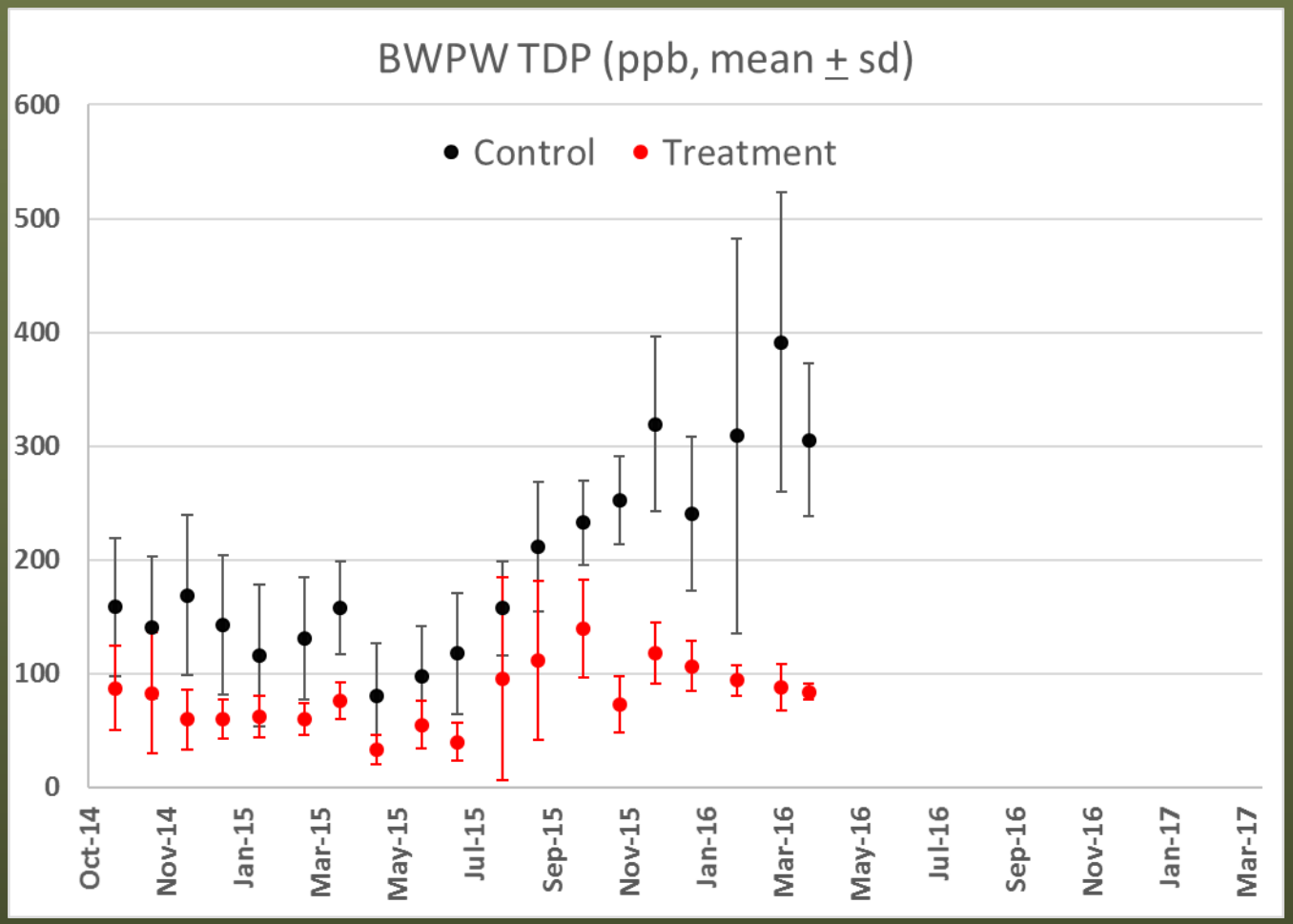




Porewater Brackish Marsh DOC (mg/l) Trend

Red = Treatments

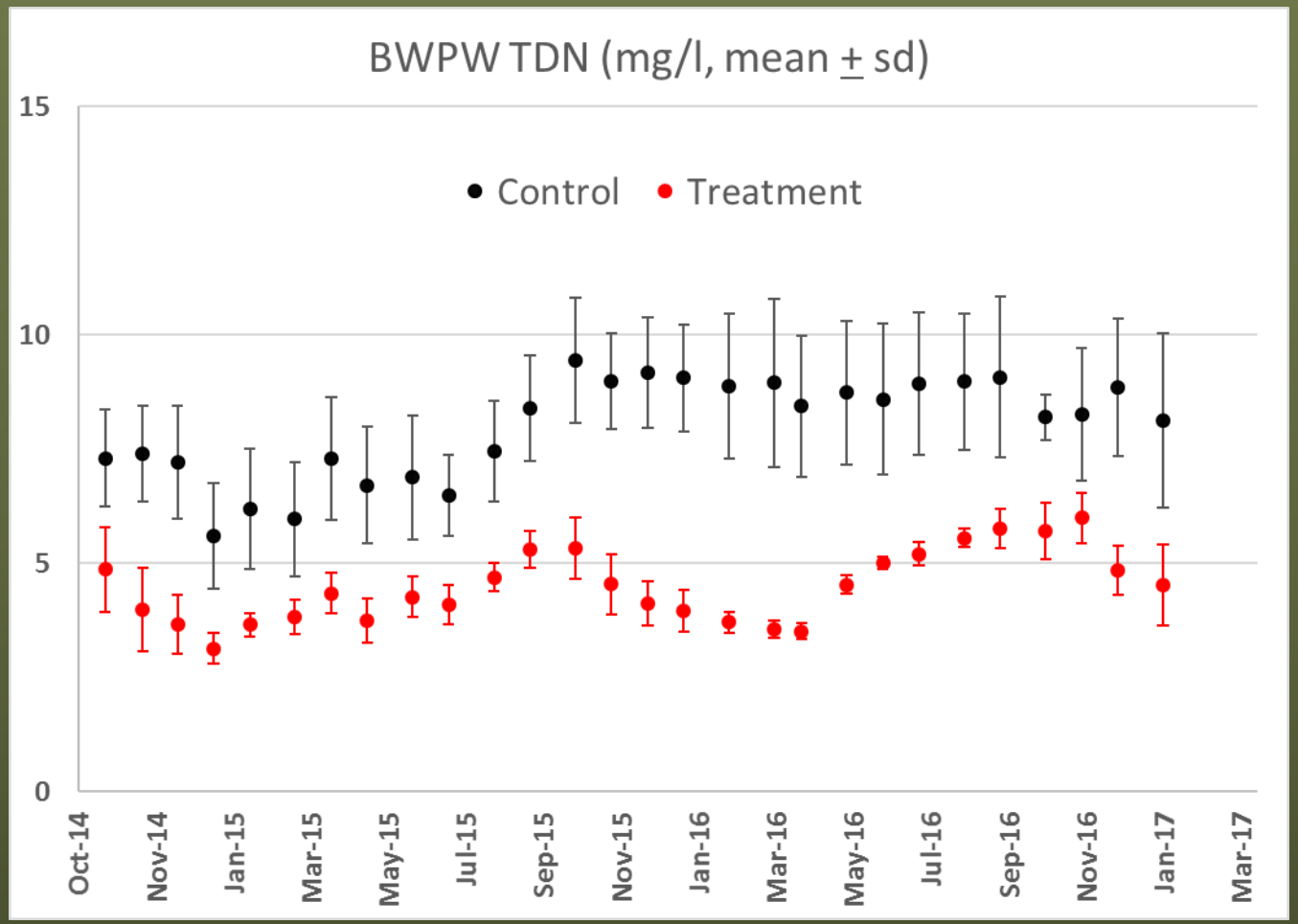
Black = Controls



Porewater Brackish Marsh Total Dissolved Phosphorus (ppb) Trend

Red = Treatments

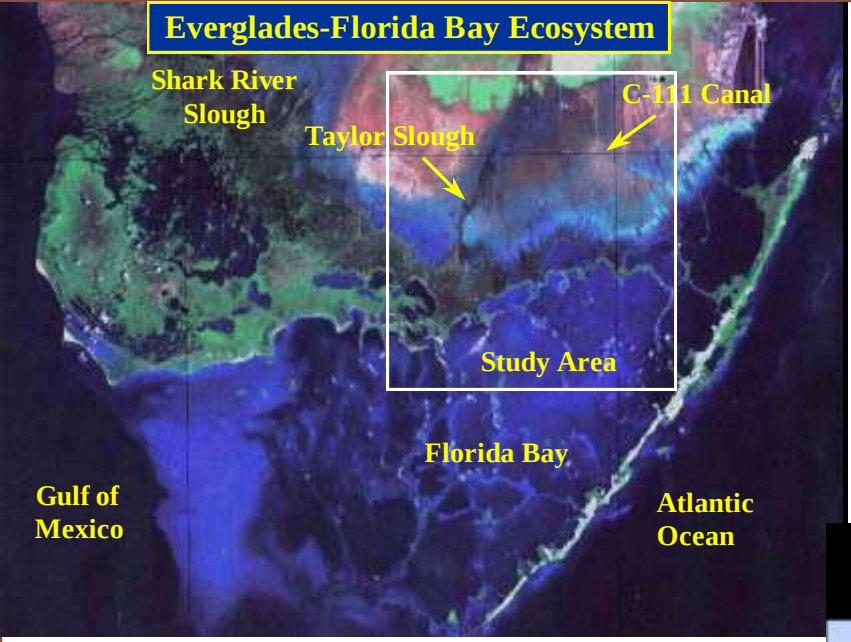
Black = Controls



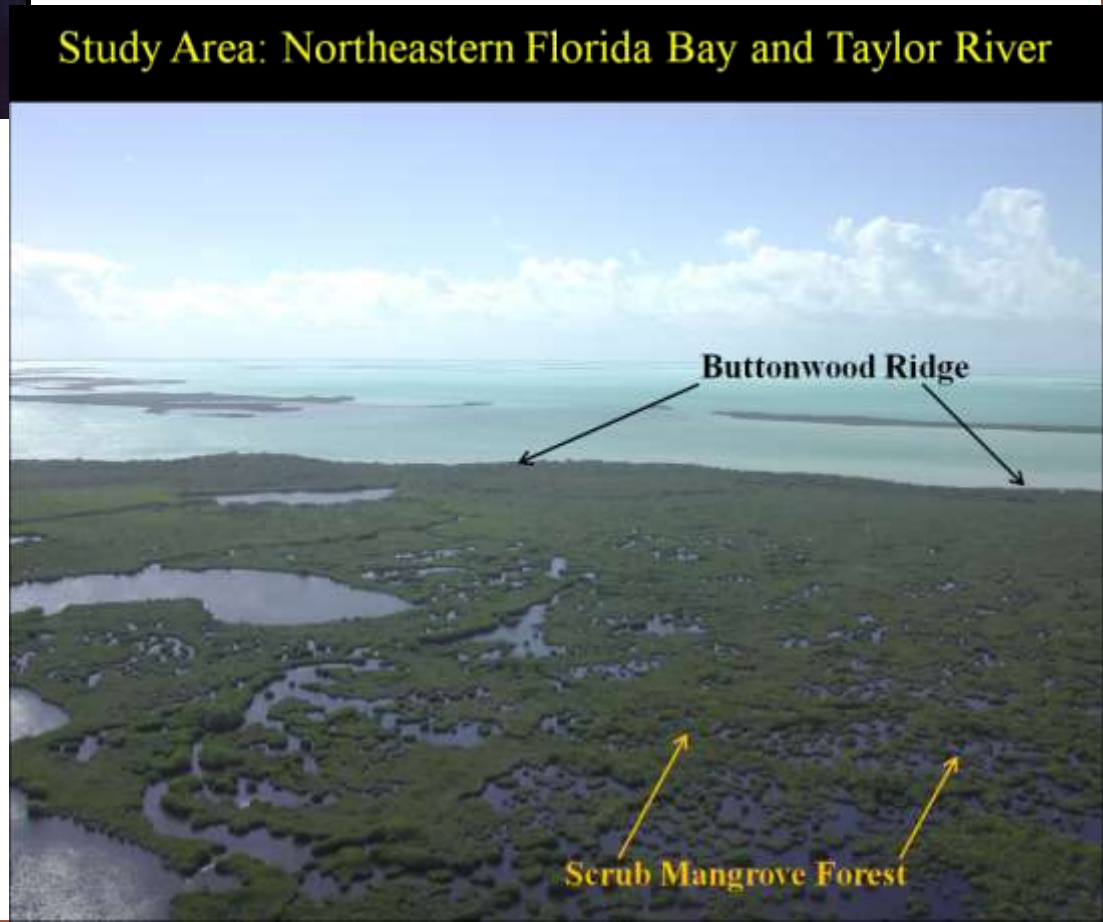
Porewater Brackish Marsh Total Dissolved Nitrogen (mg/l) Trend

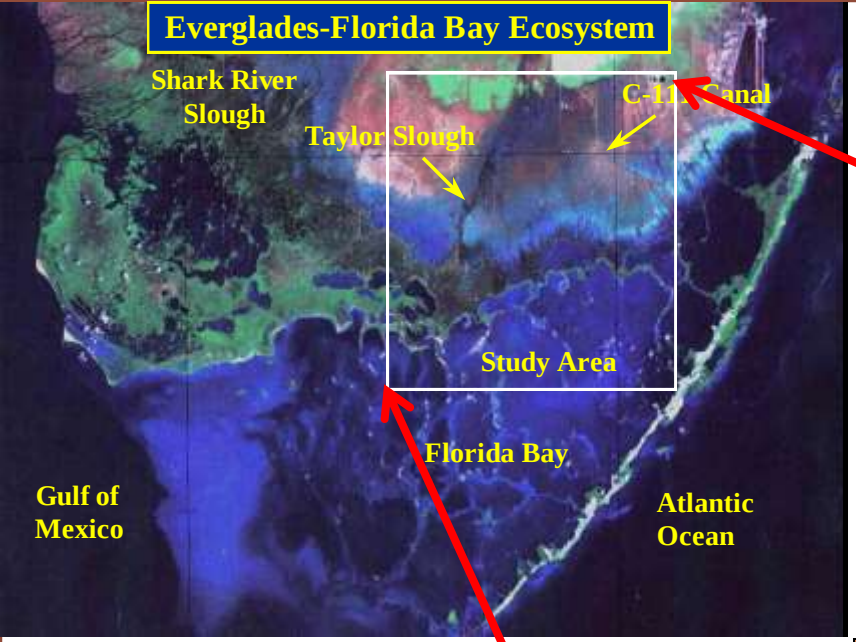
Red = Treatments

Black = Controls



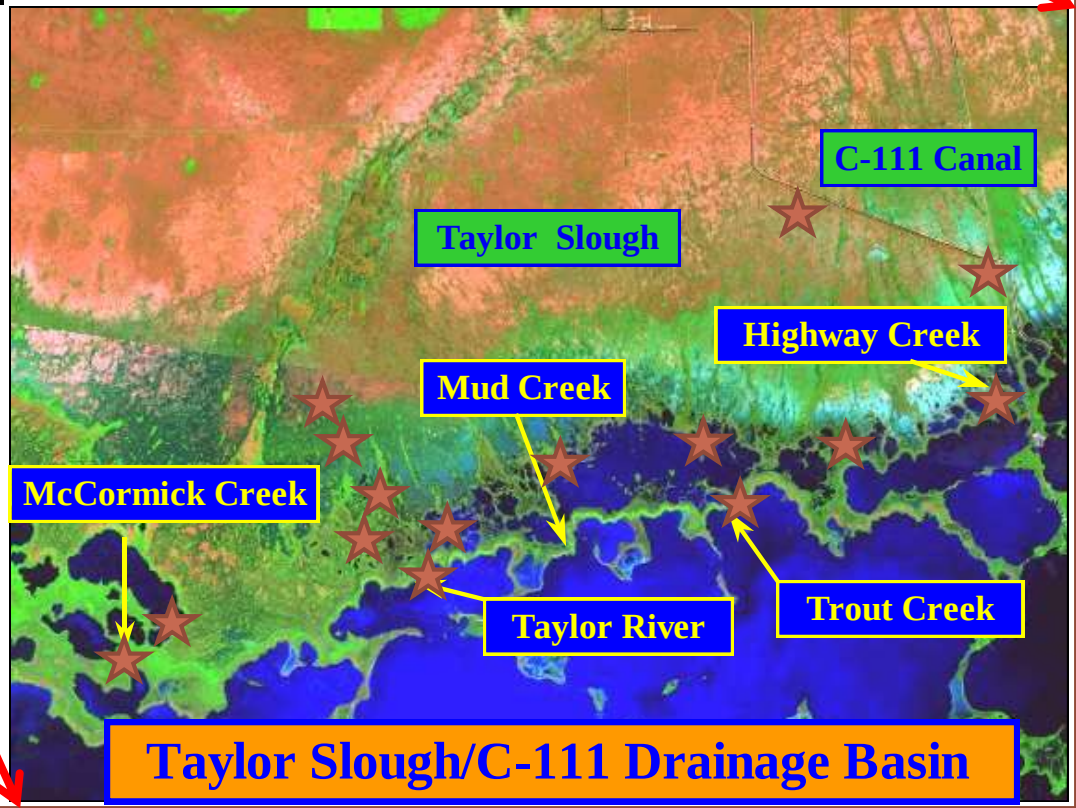
Landscape-scale Peat Collapse



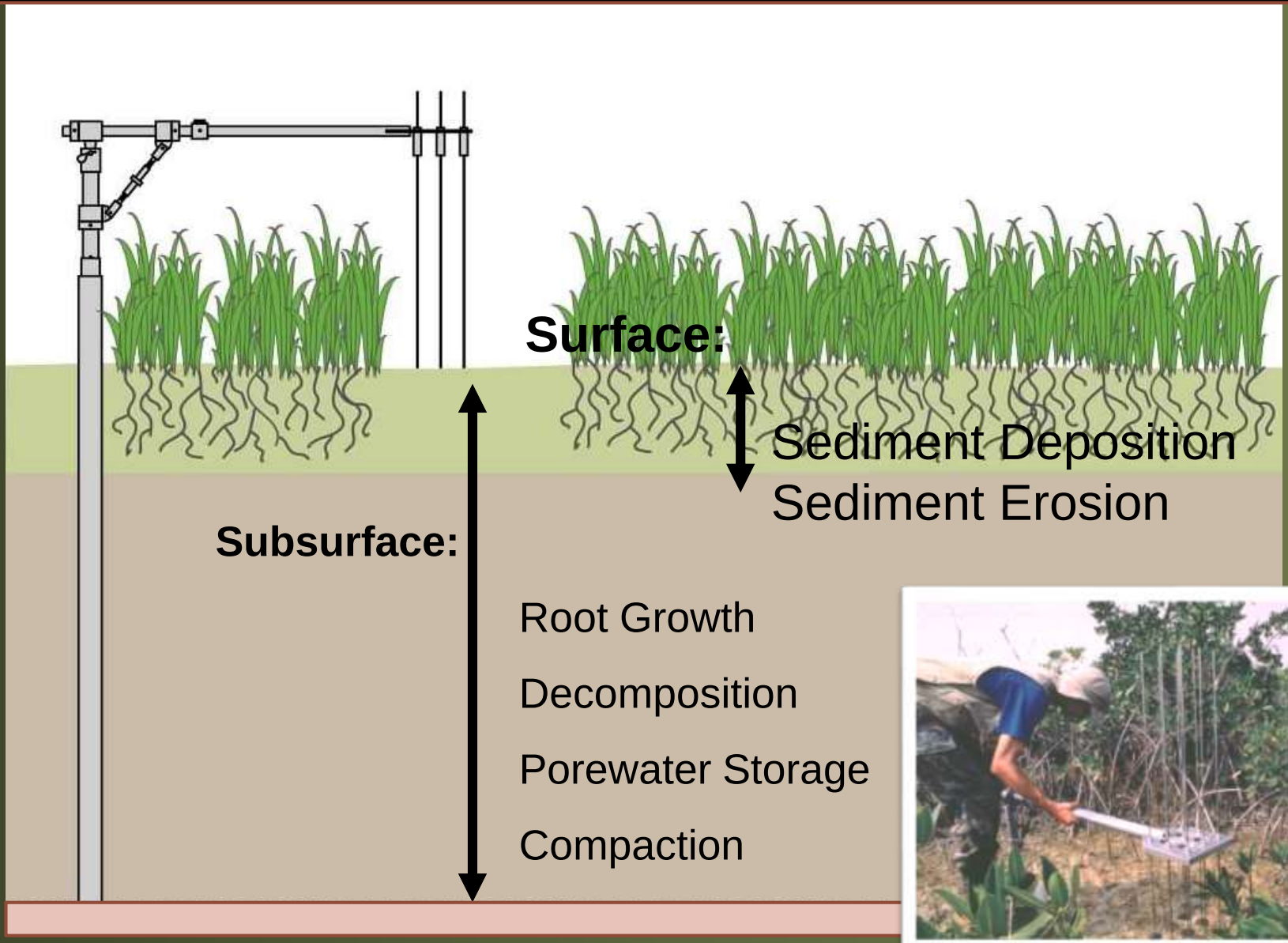


Landscape-scale Peat Collapse

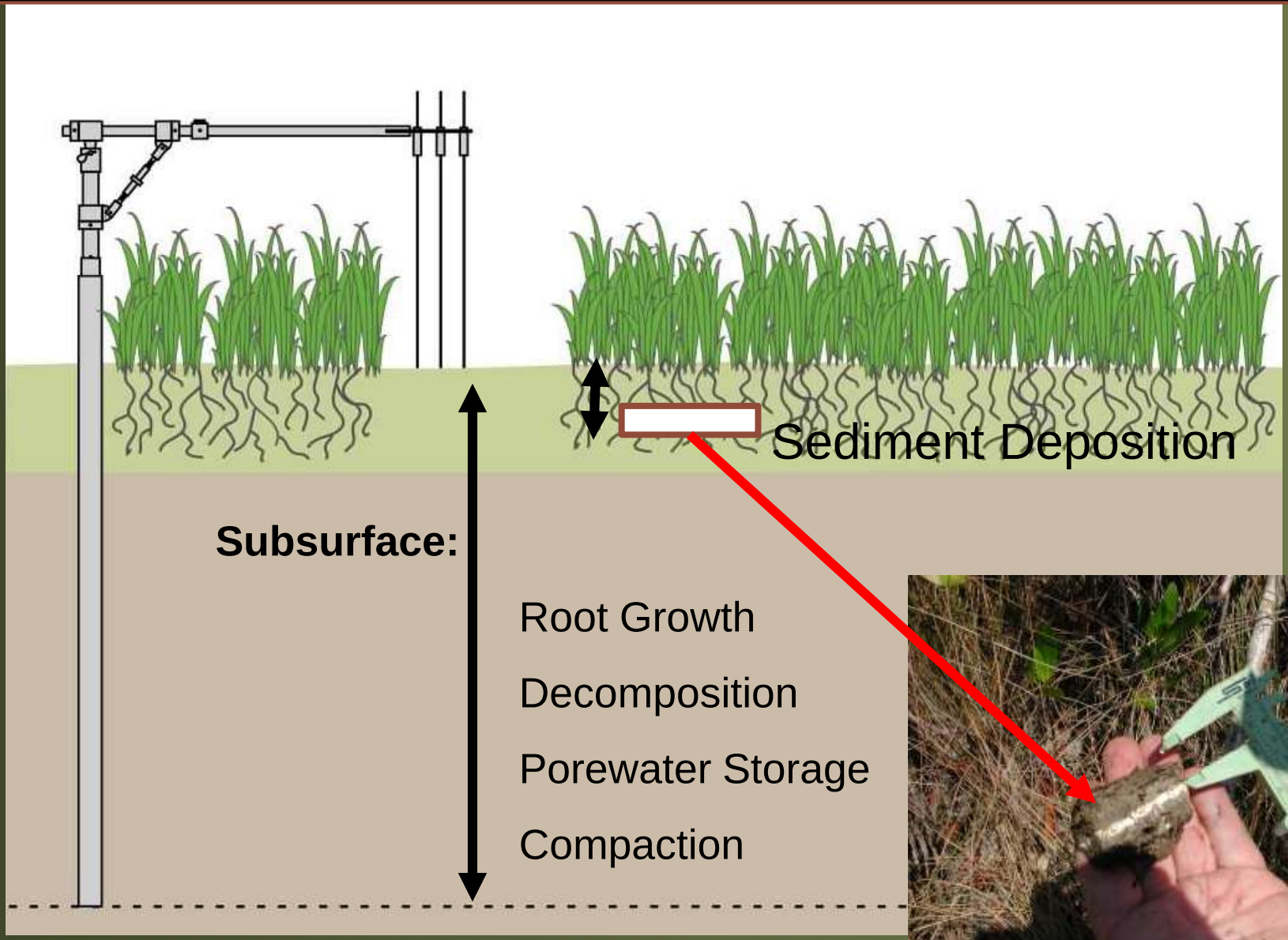
There is a Network of 21 Coastal SET (Sediment Elevation Table) Study Sites in NE Florida Bay, where accretion and elevation data have been collected annually since 1997

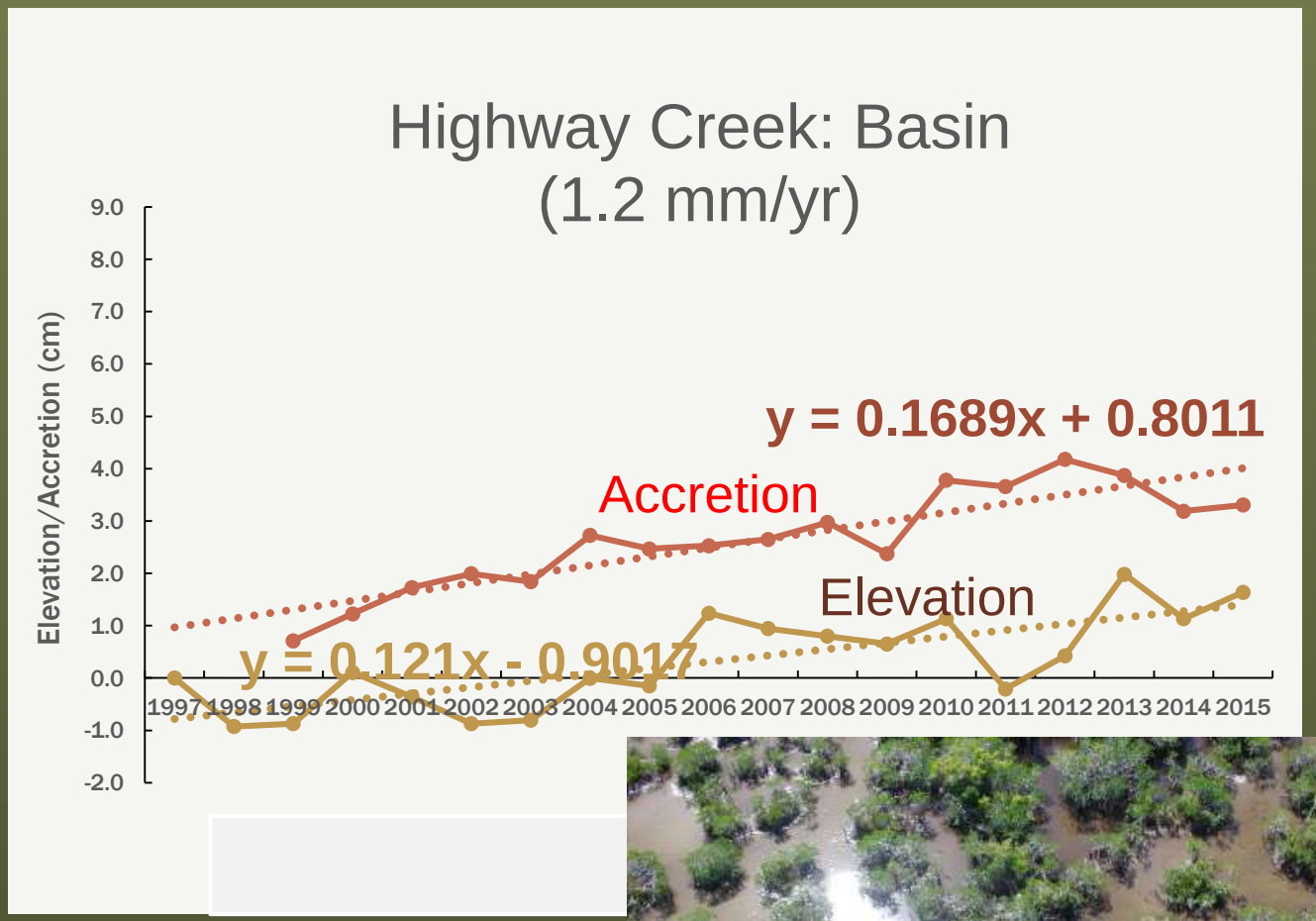


Sediment Elevation Tables (SETs) Measure Elevation Change



Feldspar Marker Horizons Measure Sediment Deposition





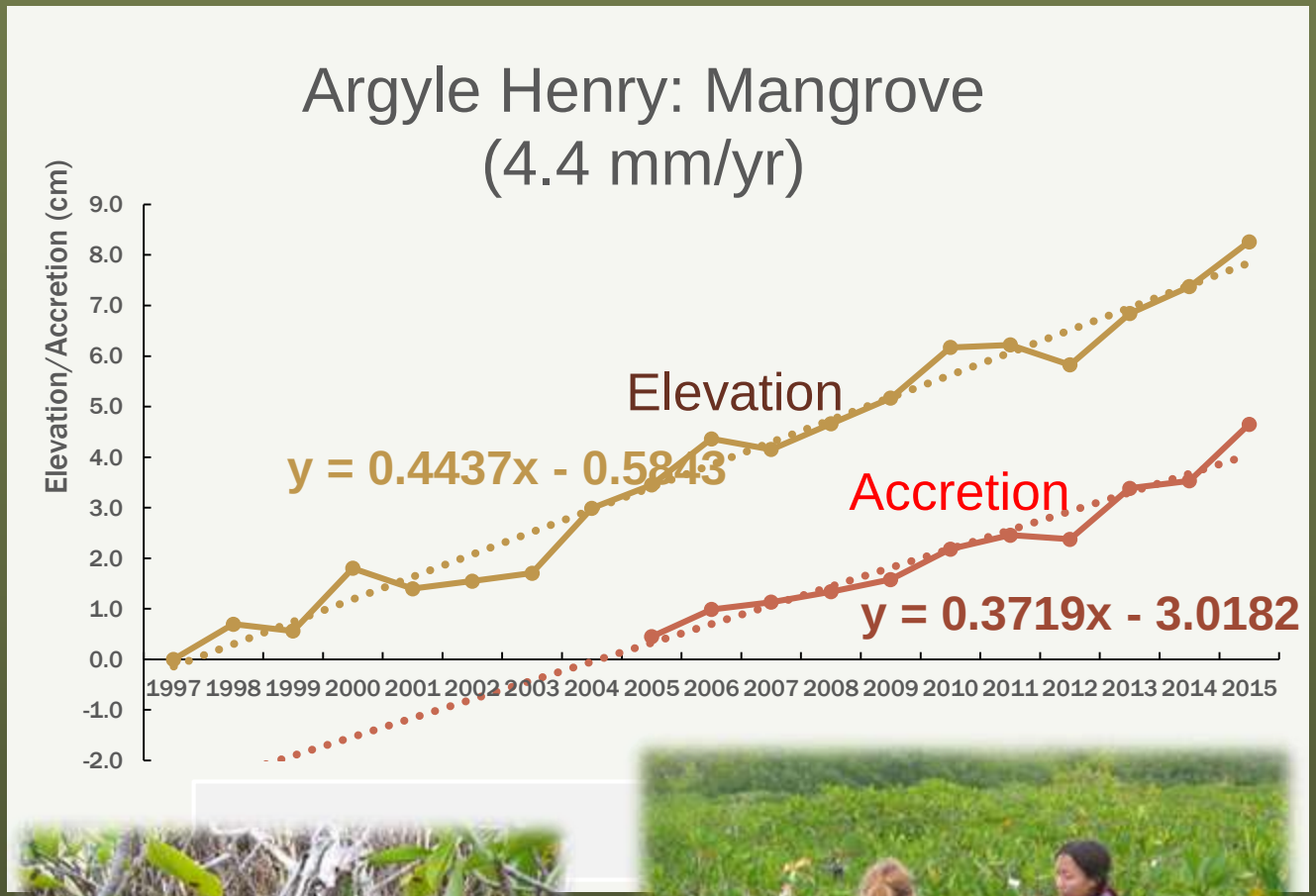
SET Data

Low flow, Low nutrients,

Always inundated

Red = Accretion

Brown = Elevation



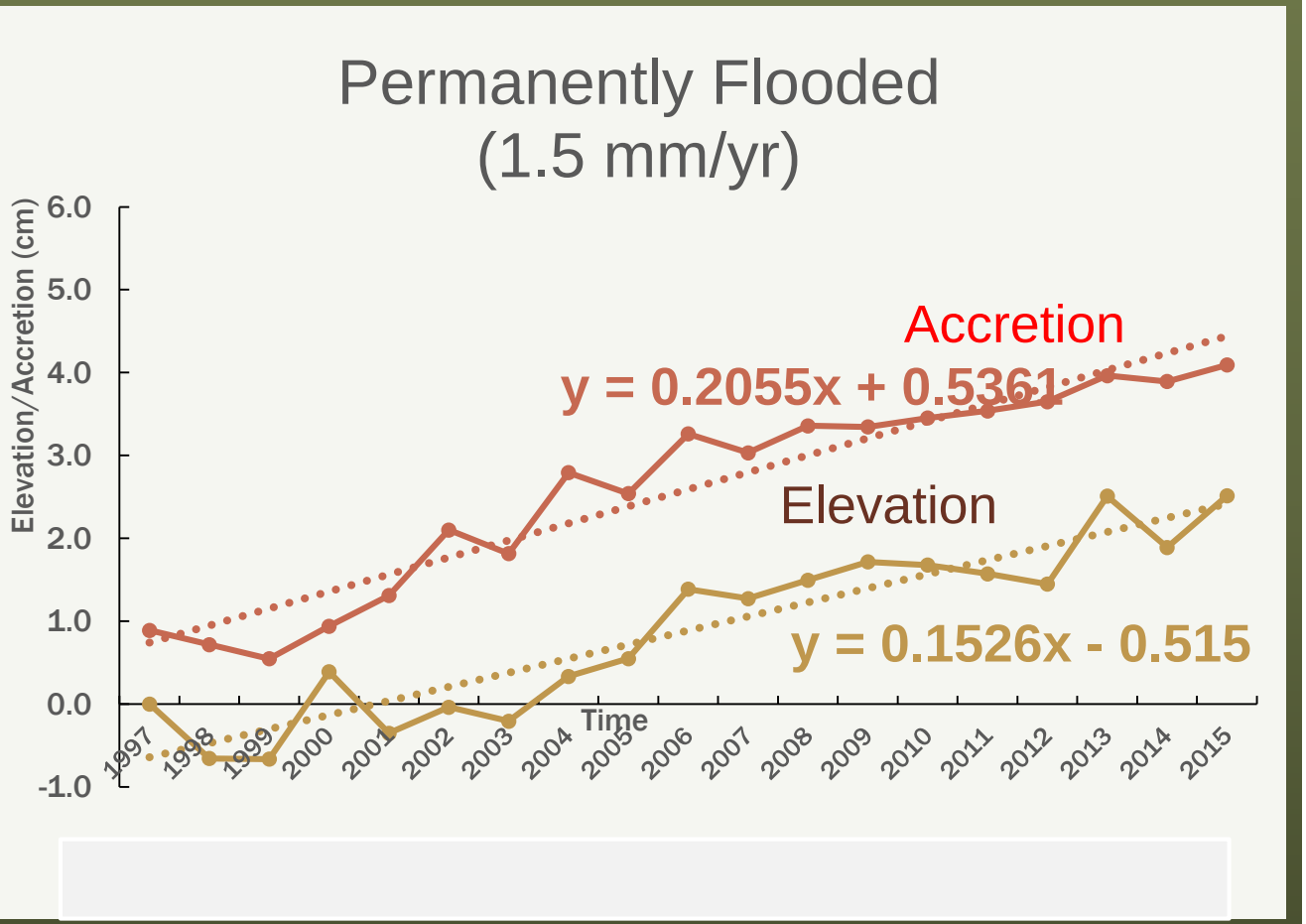
SET Data

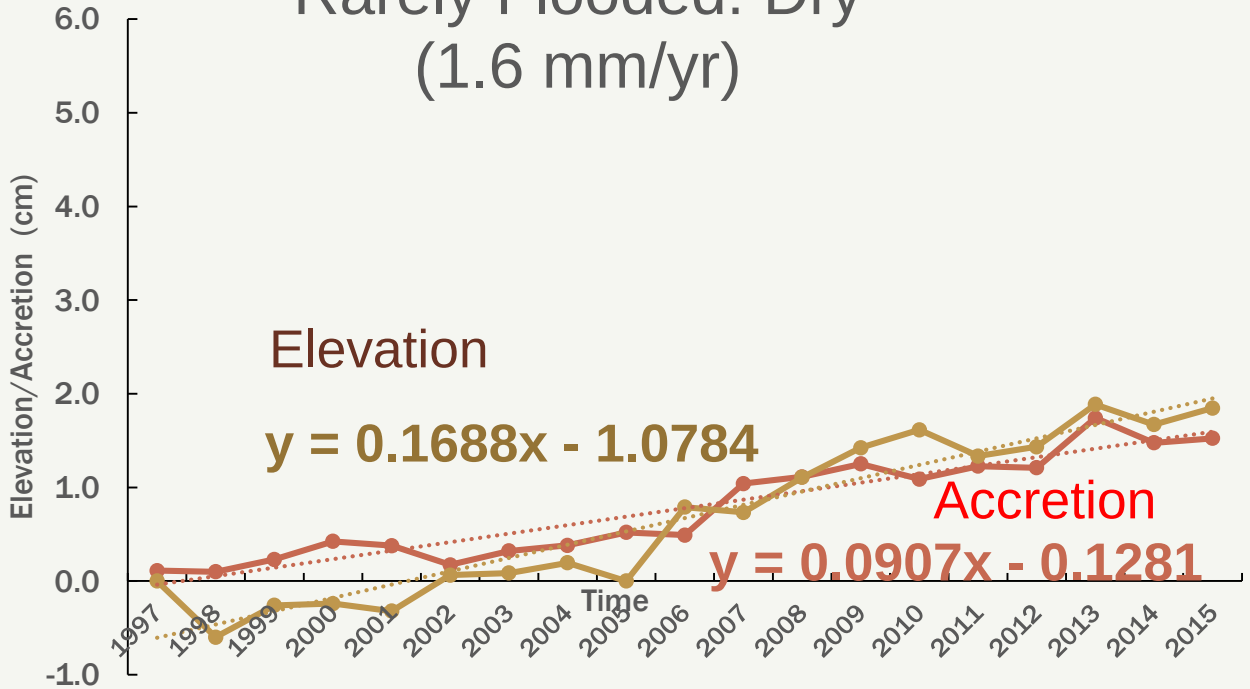
High flow, Moderate nutrients,

Seasonal inundation with Freshwater

Red = Accretion

Brown = Elevation

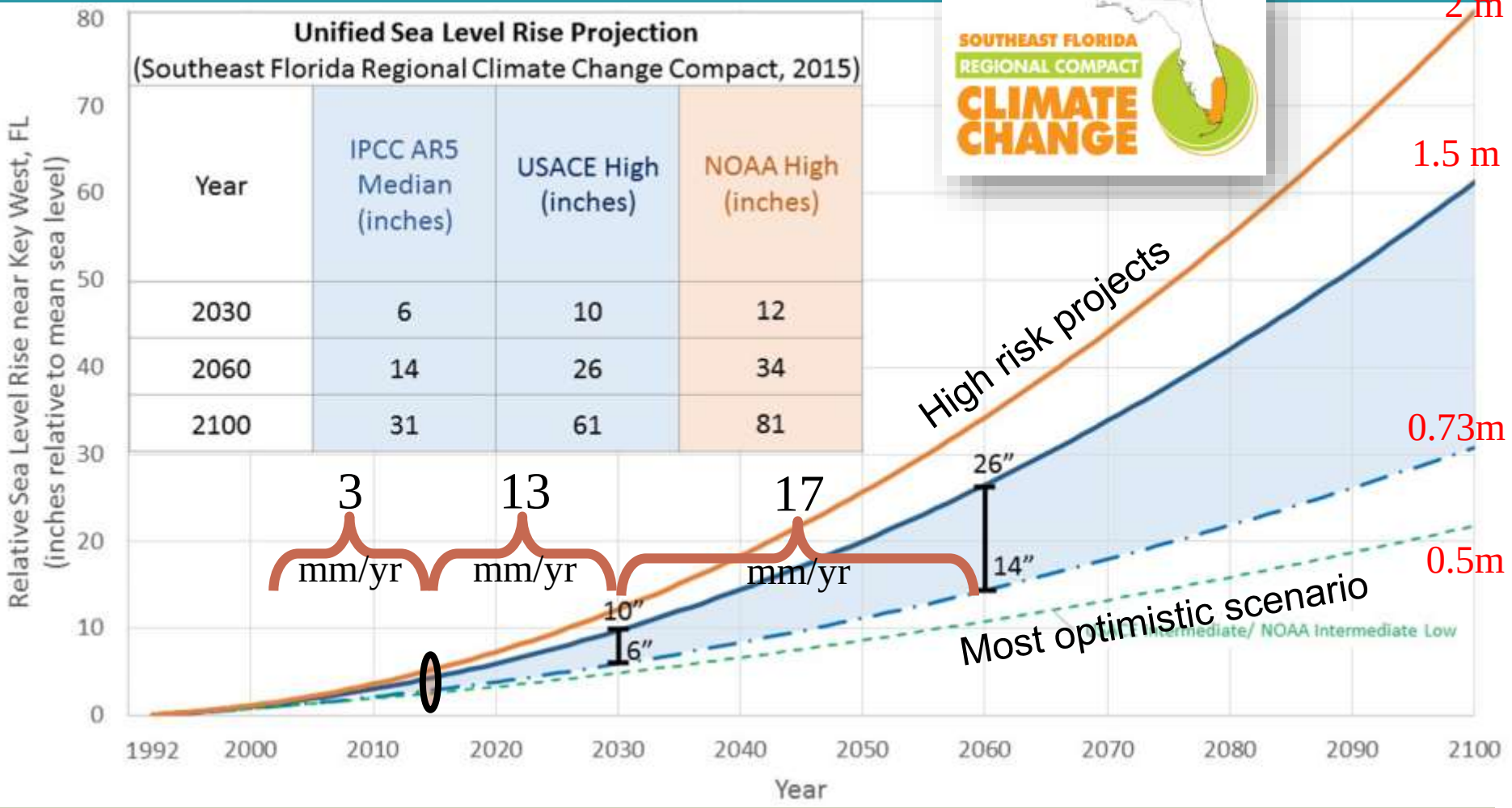

Permanently Flooded
(1.5 mm/yr)
Elevation/Accretion (cm)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Accretion
y = 0.2055x + 0.5361
Elevation
y = 0.1526x - 0.515
Time
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015


Rarely Flooded: Dry
(1.6 mm/yr)
Elevation/Accretion (cm)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Elevation
y = 0.1688x - 1.0784
Accretion
y = 0.0907x - 0.1281
Time
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015

LATEST REGIONAL SEA LEVEL PROJECTIONS

Unified Sea Level Rise Projection
(Southeast Florida Regional Climate Change Compact, 2015)

Year	IPCC AR5 Median (inches)	USACE High (inches)	NOAA High (inches)
2030	6	10	12
2060	14	26	34
2100	31	61	81



1. *The chemistry of Peat Collapse is not yet clear. However, salt stress can:*
   a) *Enhance carbon flux out of the soils during the dry season and*
   b) *Suppress DOC, N and P release from plant-peat matrix.*
2. *High flow, seasonally inundated mangroves are the most likely habitat to keep up with SLR, but not for long.*

Conclusions

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Opinion:

1. *Restoration of historic flows to the Everglades has the potential to mitigate for peat collapse and facilitate the migration of mangroves inland.*
2. *In the face of accelerating sea level rise and increasing ET associated with climate change, there is an urgent need to maximize the adaptive capacity of coastal systems.*

THANK YOU

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