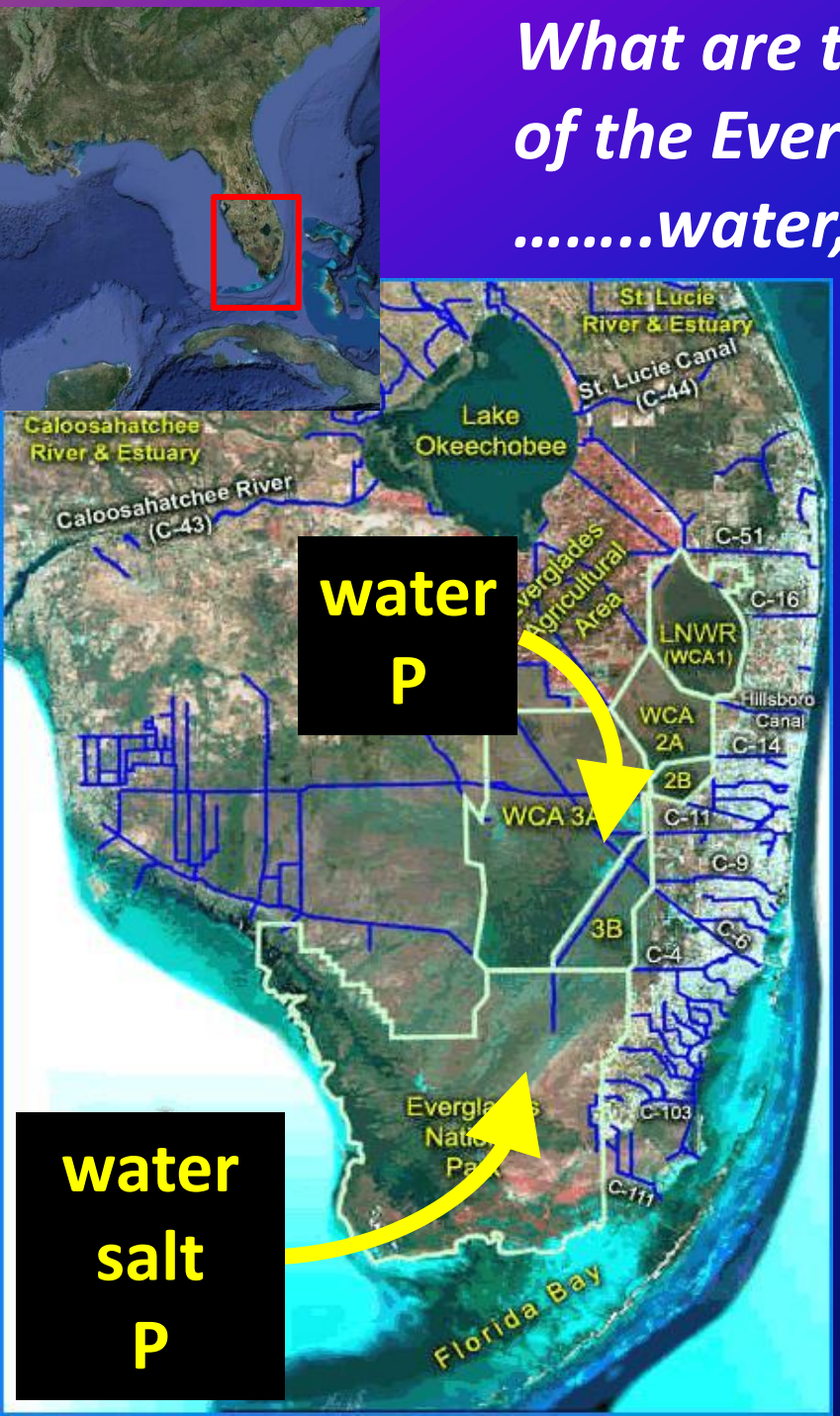
Restoration of the Everglades' Saline Wetlands and Florida Bay: Responses Driven from Land and Sea

David Rudnick[1], Colin Saunders[2], Carlos Coronado[2], Fred Sklar[2]
Erik Stabenau[1], Vic Engel[1], Rene Price[3]

[1] South Florida Natural Resources Center, Everglades National Park
[2] Everglades Systems Assessment Section, South Florida Water Management District
[3] Dept. of Earth and Environment, Florida International University

9th INTECOL
Orlando, Florida
June 7, 2012

What are the primary manageable drivers of the Everglades - Florida Bay Ecosystem? ……..water, salt, phosphorus



Human development drained water & added P, yielding:

- dry wetland; soil oxidation
- hypersaline estuary & salt-water intrusion
- altered ecosystem structure and function

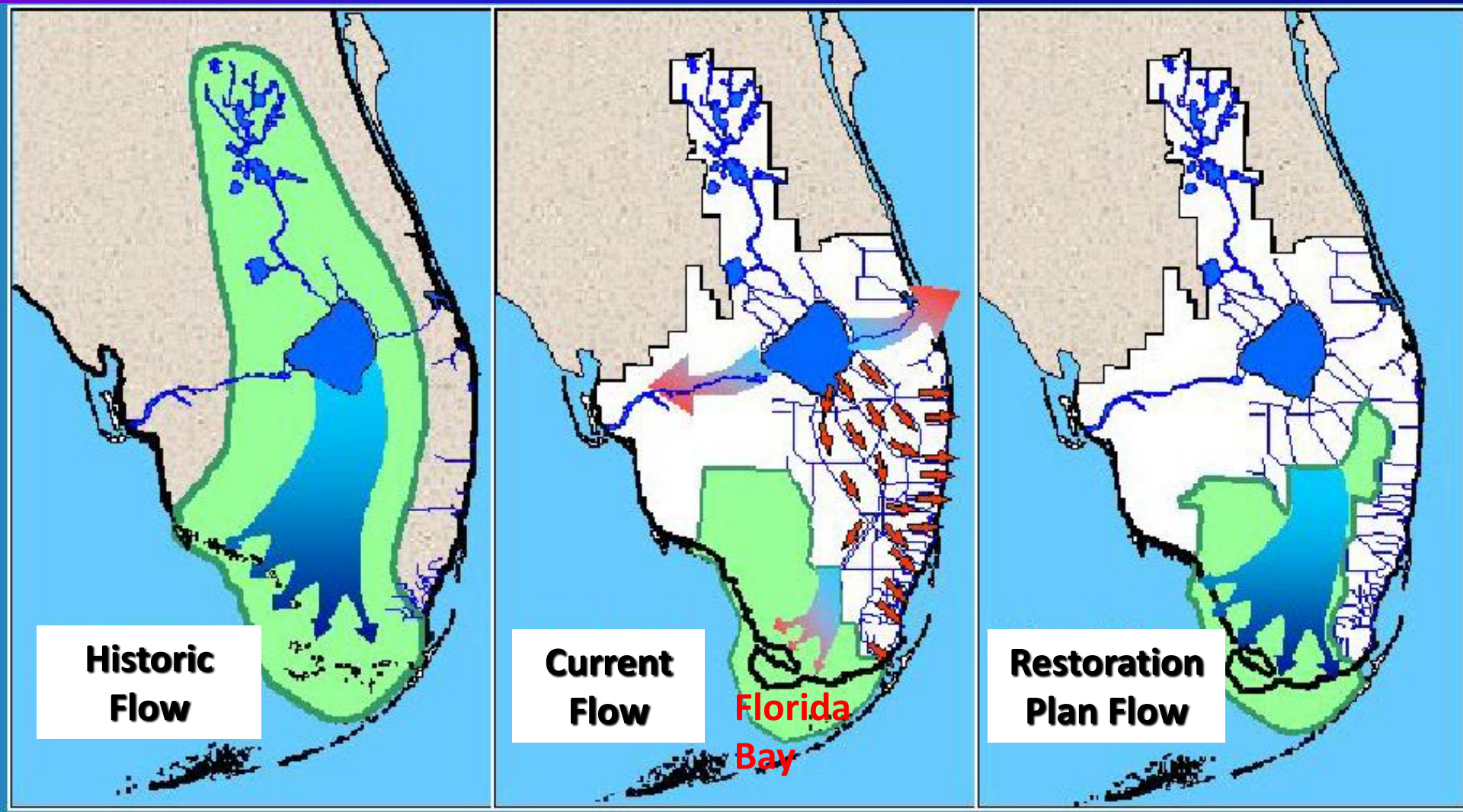
Sea-level rise is:

- increasing saltwater intrusion
- increasing P input from the Gulf of Mexico

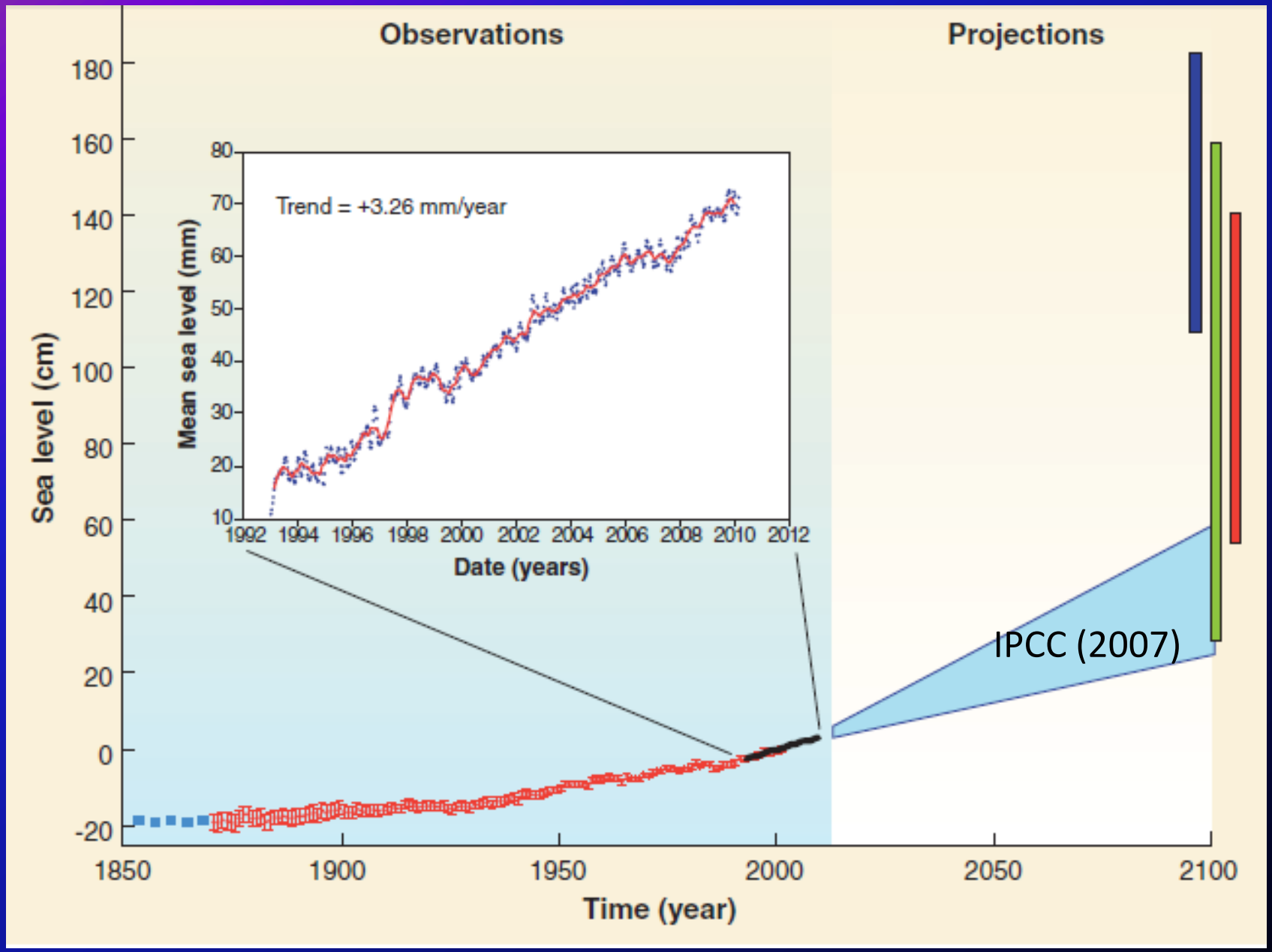
Restoration can push back against the trajectory of each of these forcings

Today : discuss the state & future of the restoration – sea-level rise contest

Everglades Restoration:
Freshwater flow from Kissimmee River to Florida Bay

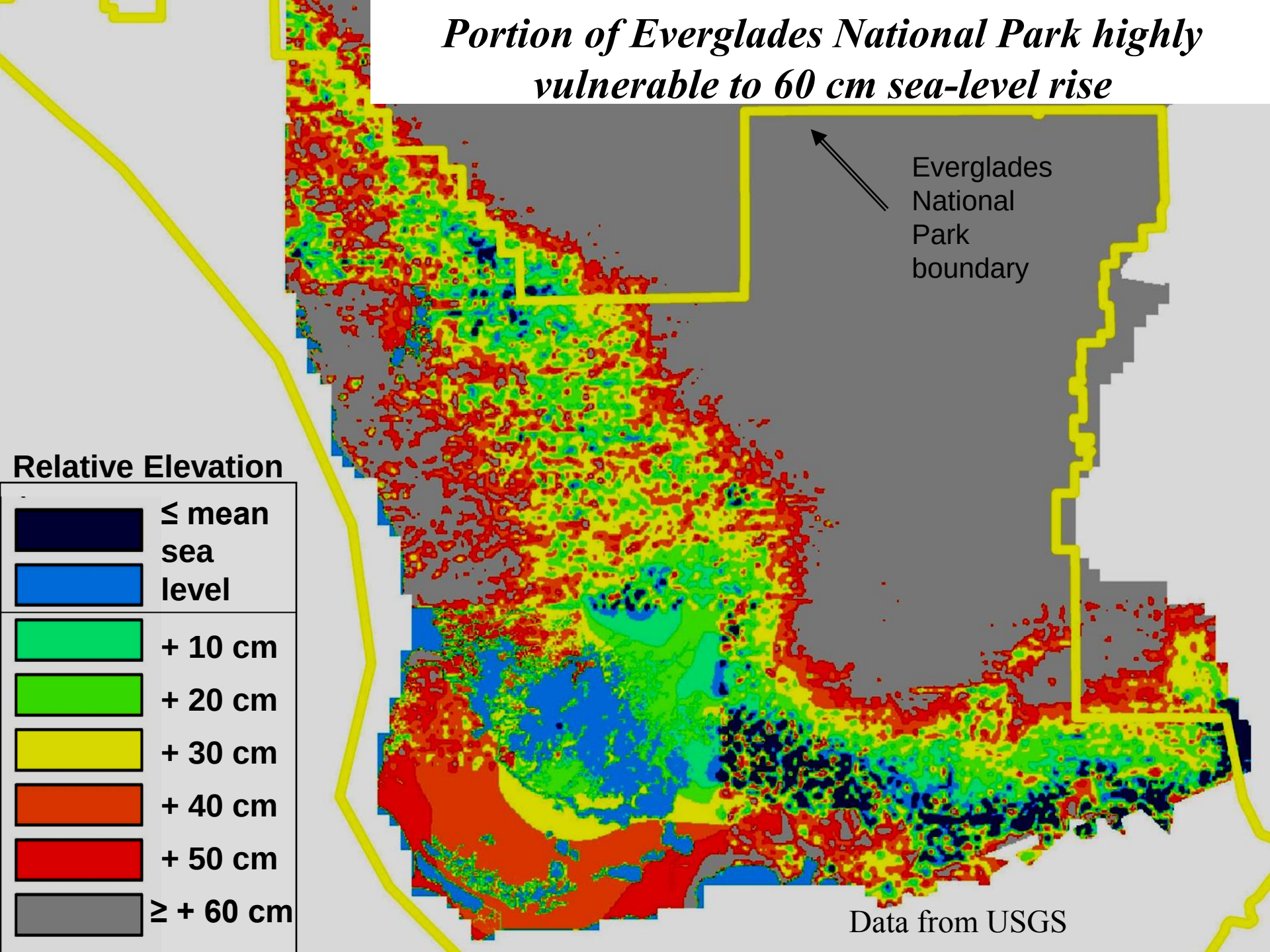


Global sea-level rise trend and projections



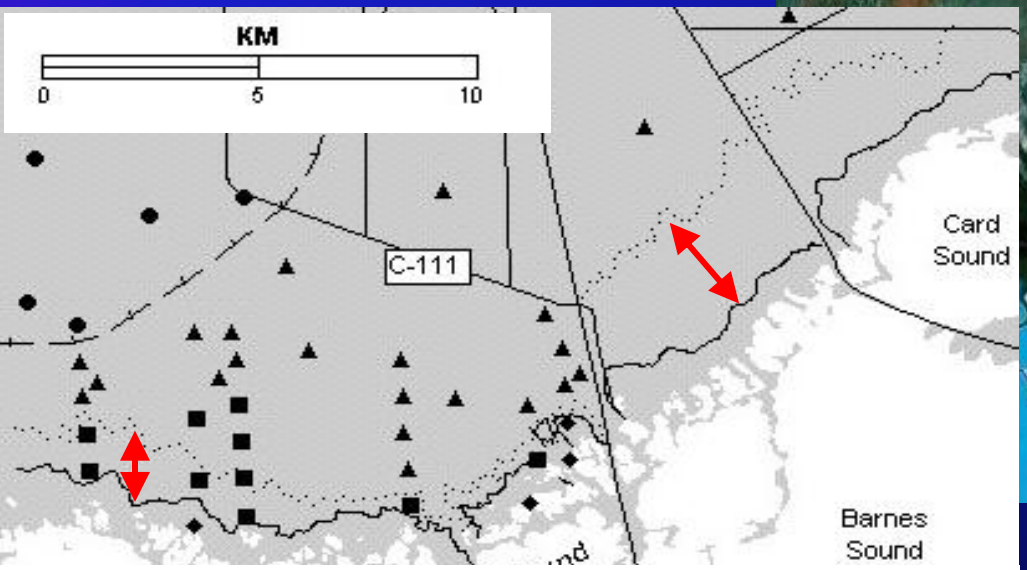
From Nicholls and Cazenave (2010)

Portion of Everglades National Park highly vulnerable to 60 cm sea-level rise

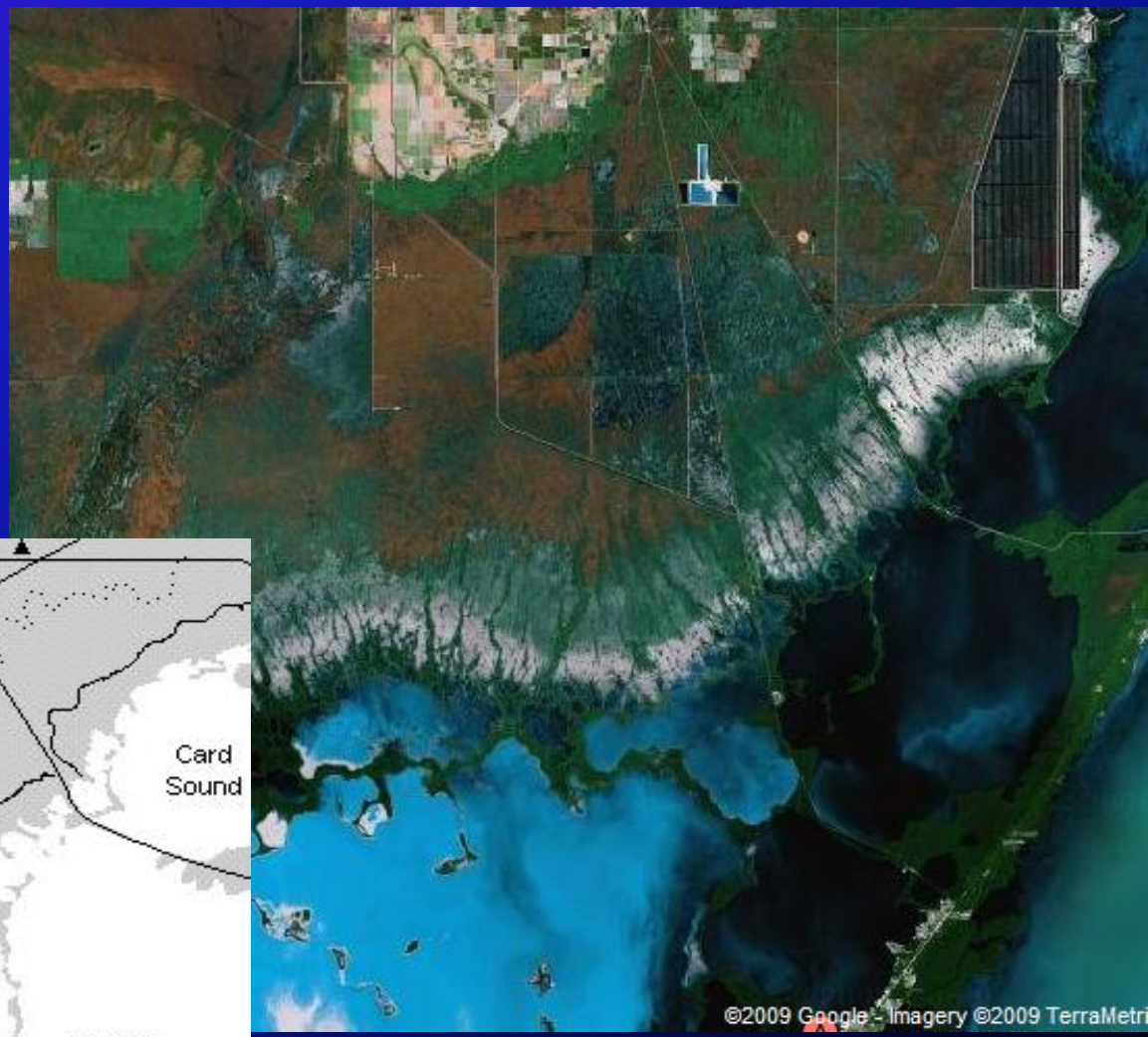


Saltwater Intrusion Caused by Freshwater Diversion and Sea-level Rise

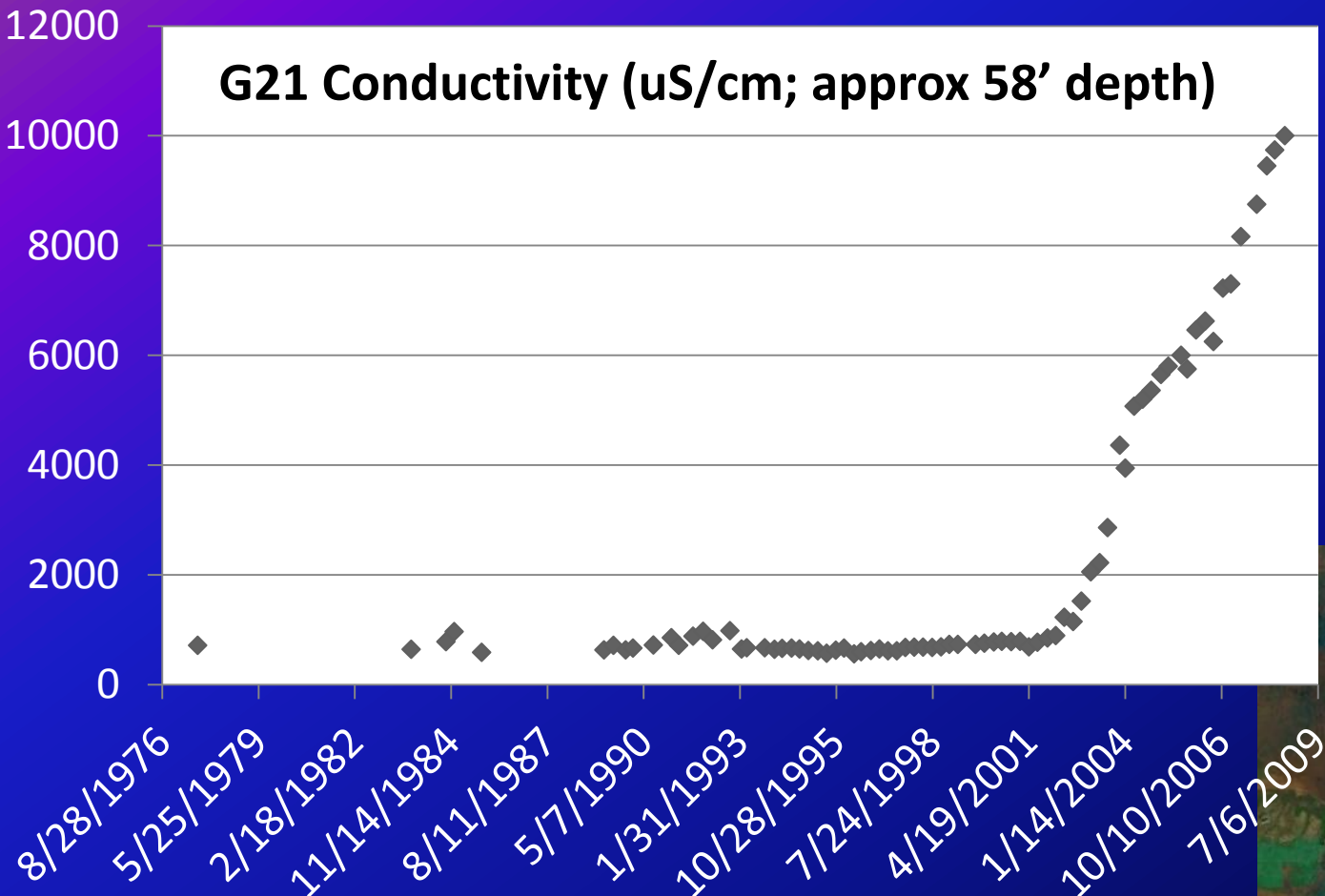
Saltwater intrusion with expanding “white zone” is more extensive east of Everglades National Park

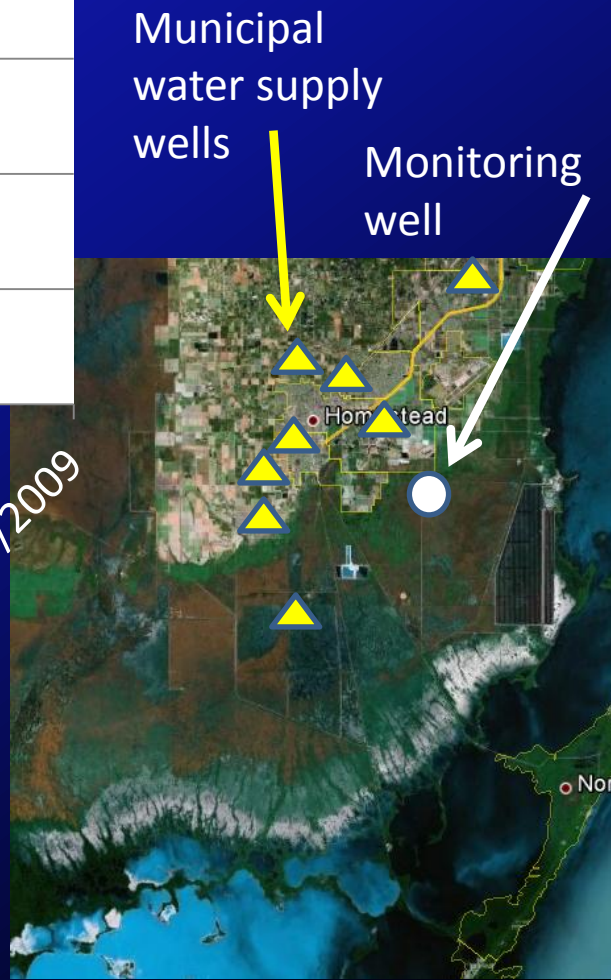


White zone expanded 1-3 km from 1940-1994 (from Ross et al. 2000)

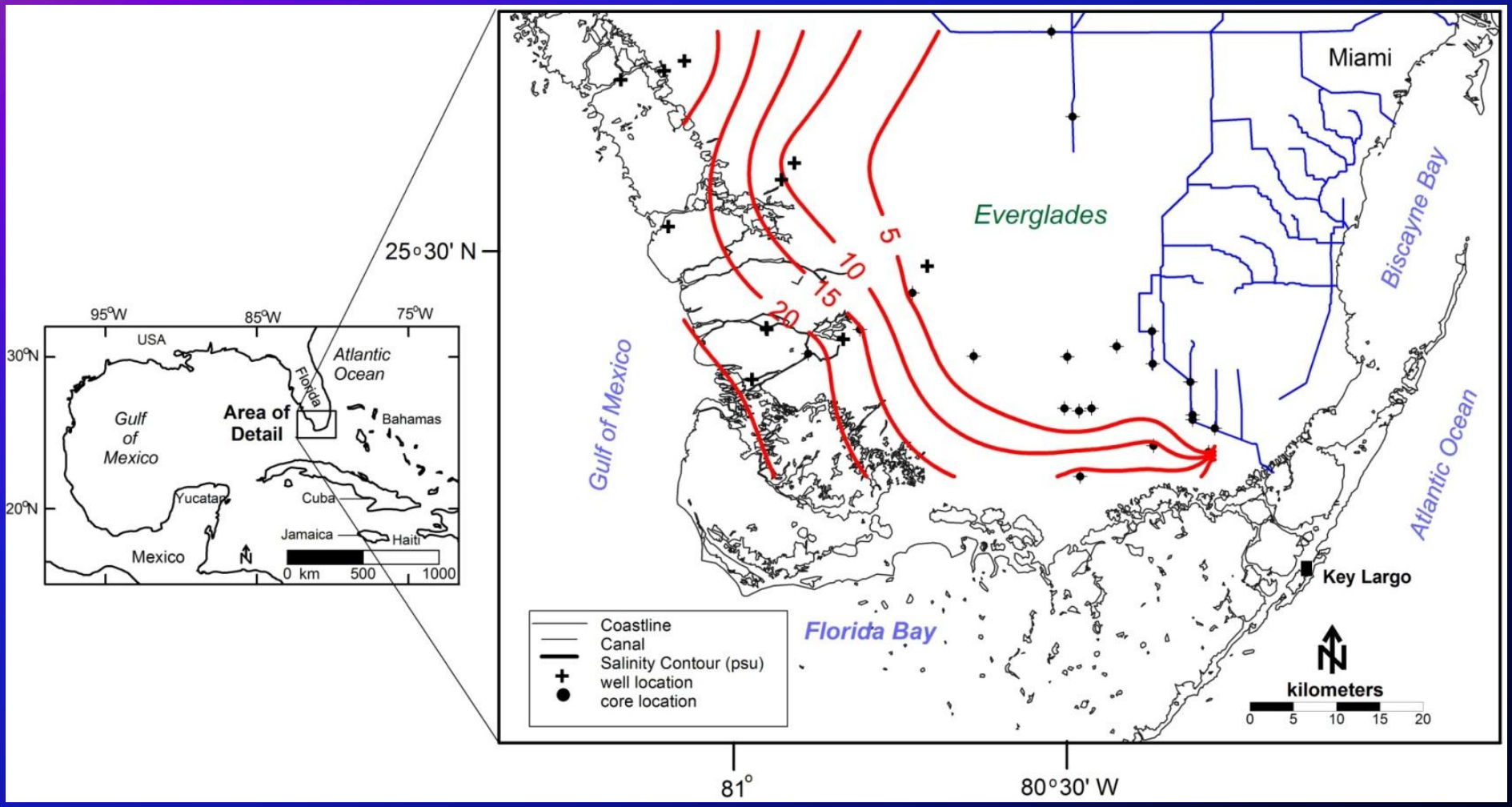


Saltwater Intrusion in Southeastern Groundwater Well



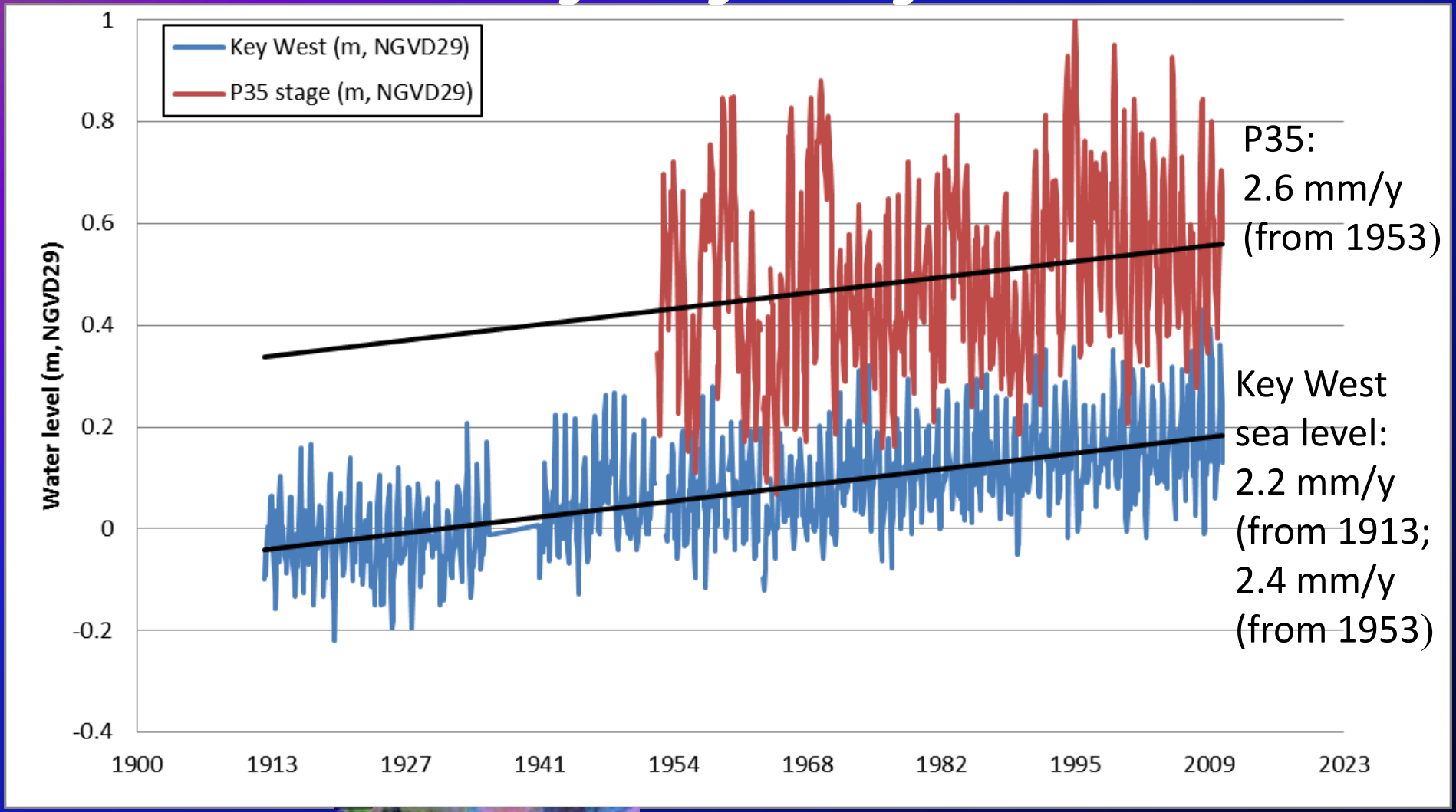


Saltwater Intrusion: Shallow Groundwater (<25 m)

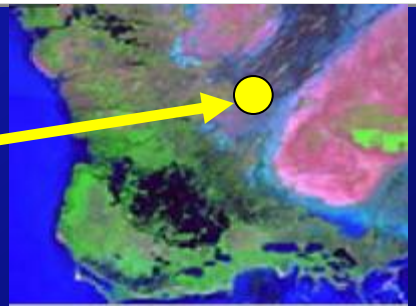


From Price et al. 2006

Shark River Slough Stage Rising With Sea Level



Station
P35

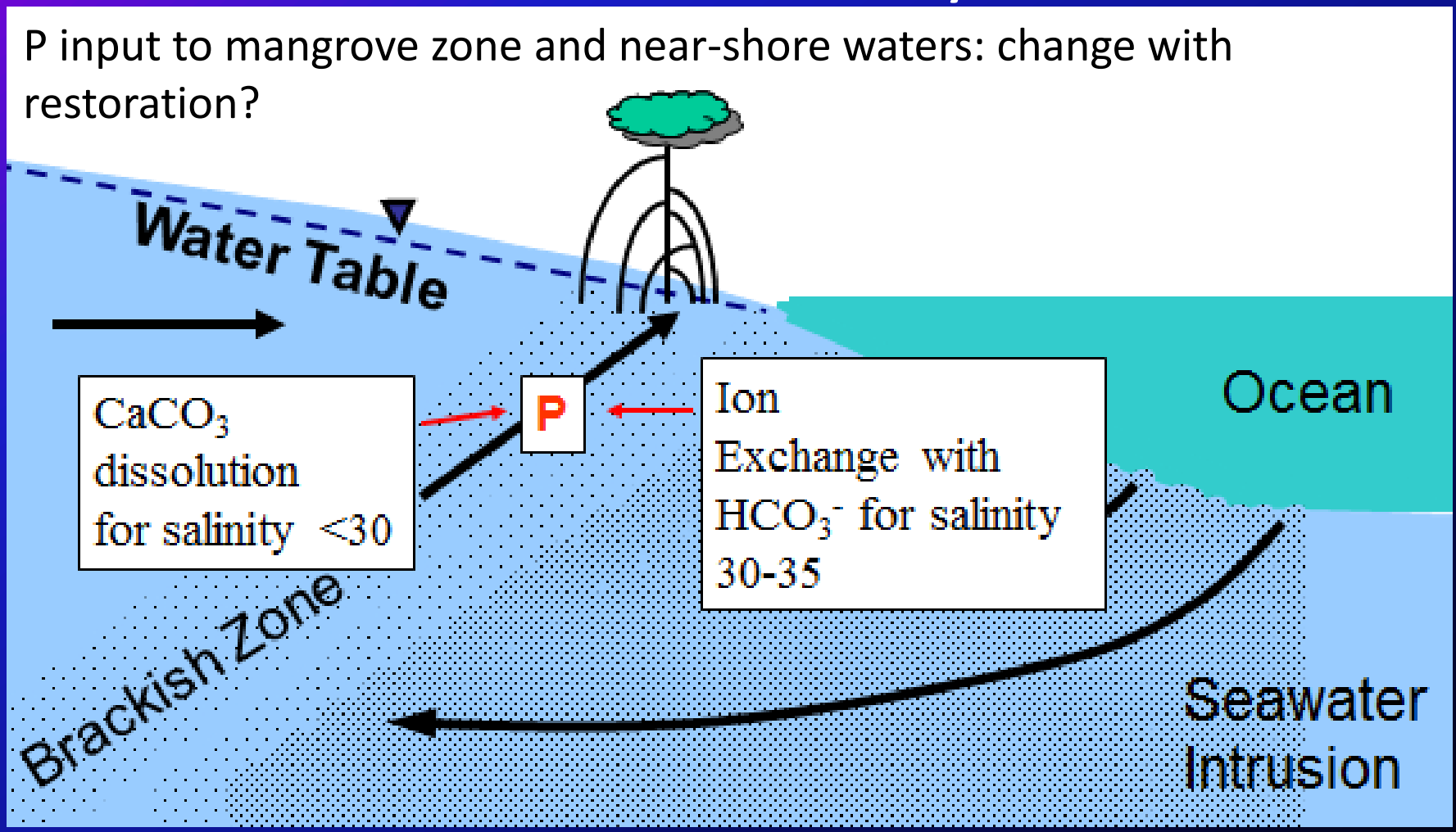


If shallower hydrologic slope, higher stages, increased inundation, slower flow, longer residence time.

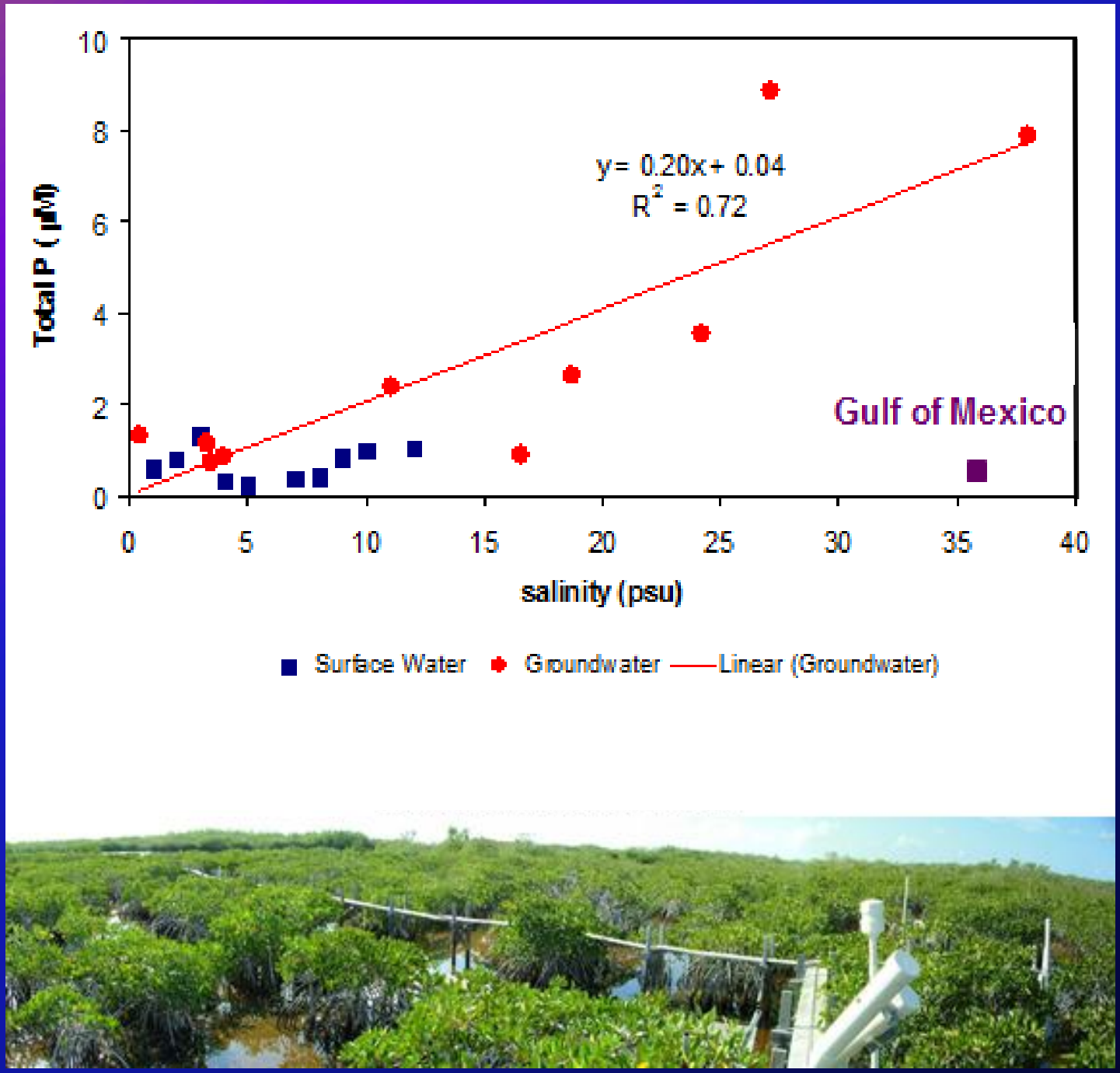
Biogeochemical Effects of Saltwater Intrusion

Conceptual model: increased saltwater intrusion increases subsurface P mobility and flux

P input to mangrove zone and near-shore waters: change with restoration?



From Price et al. 2010

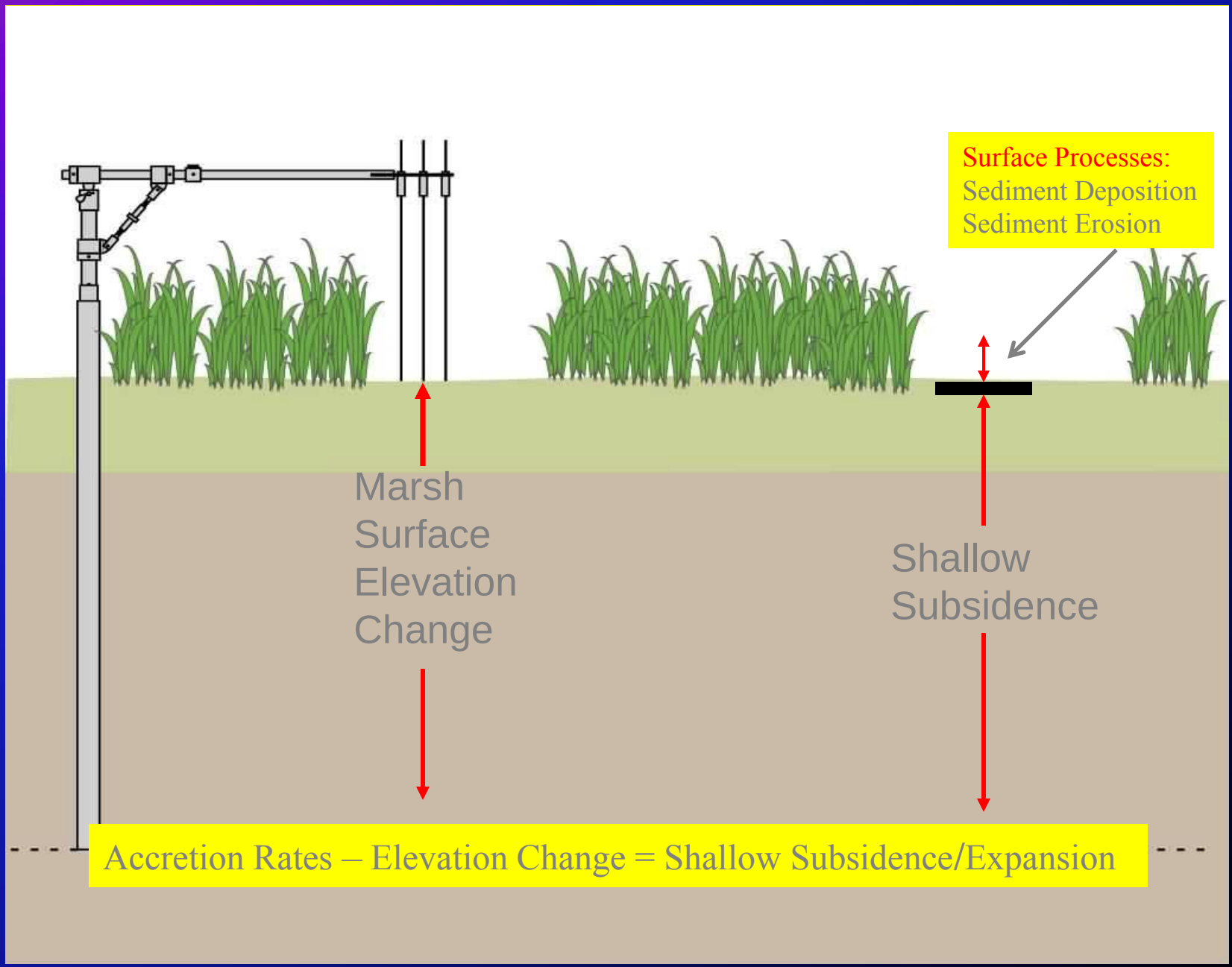


Phosphorus Input from Groundwater?

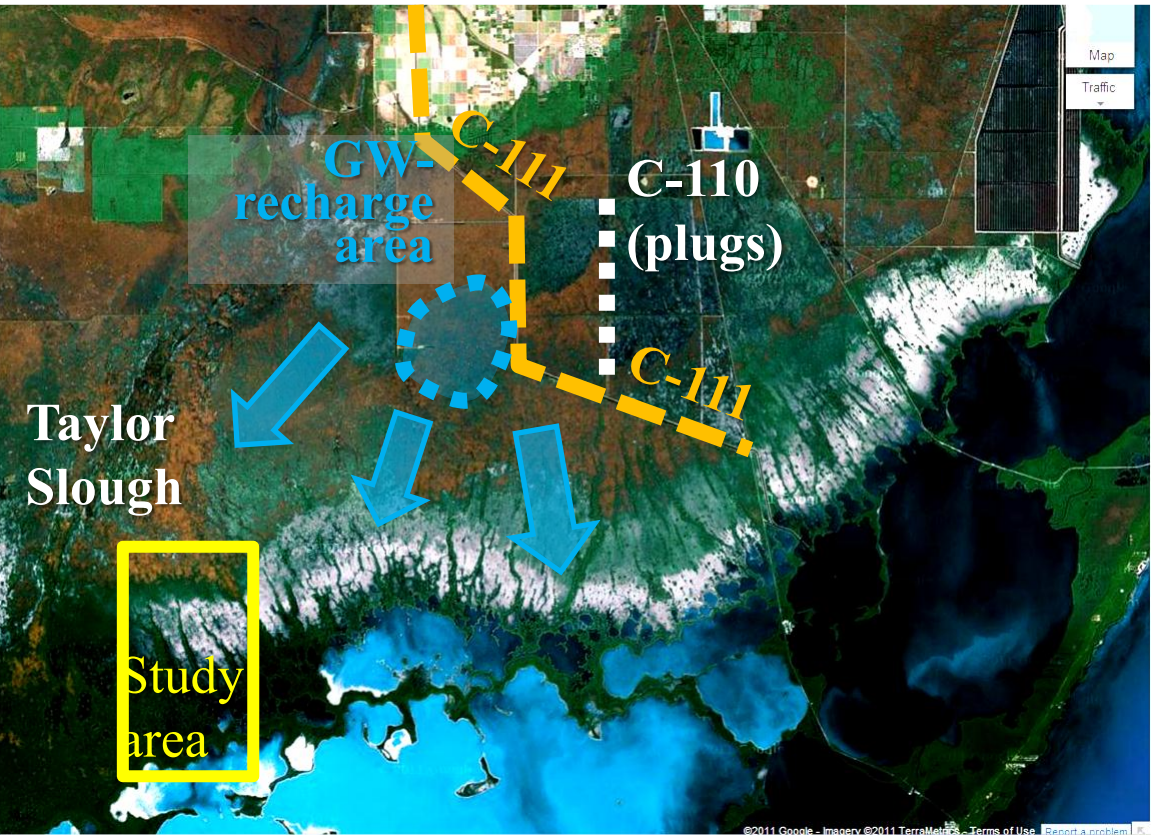
Evidence that saltwater intrusion may cause the release of phosphorus from bedrock to the mangrove zone and estuaries

From Price et al. 2006

Surface Elevation Tables (SETs)

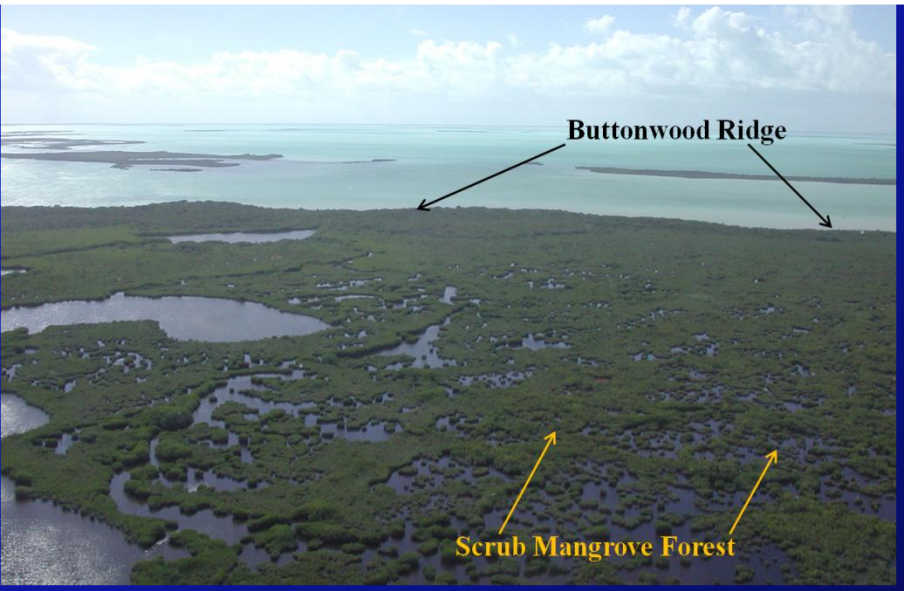


Coastal Wetland SET Study Area



Non-flooded: Buttonwood Ridge

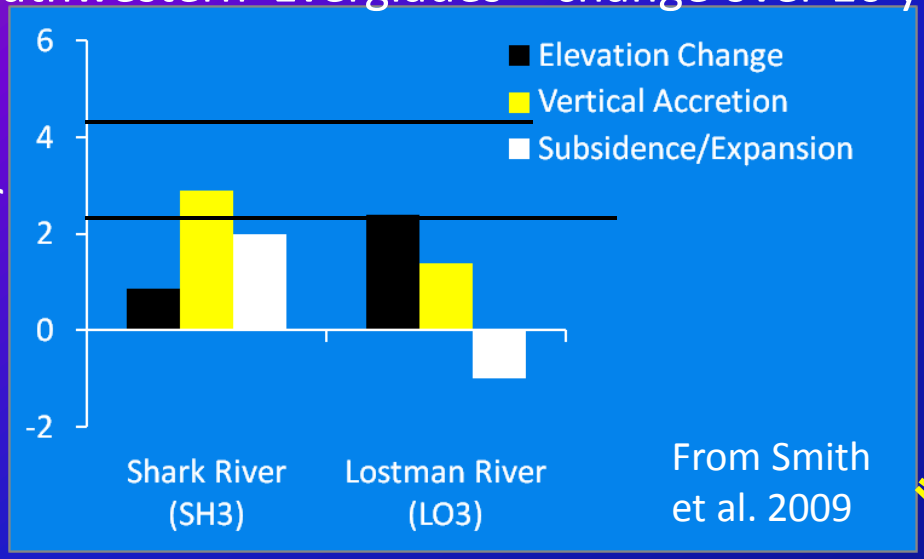
Frequently flooded



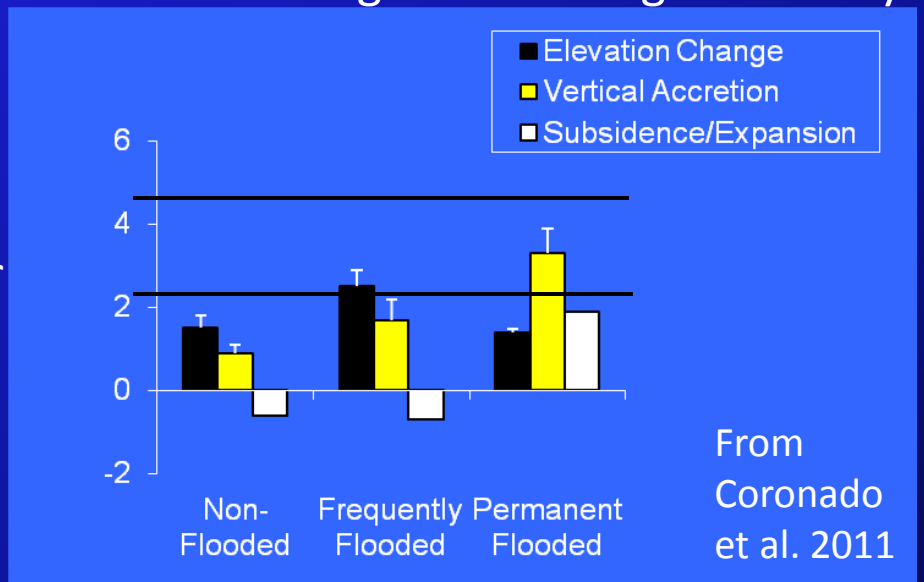
Permanently flooded

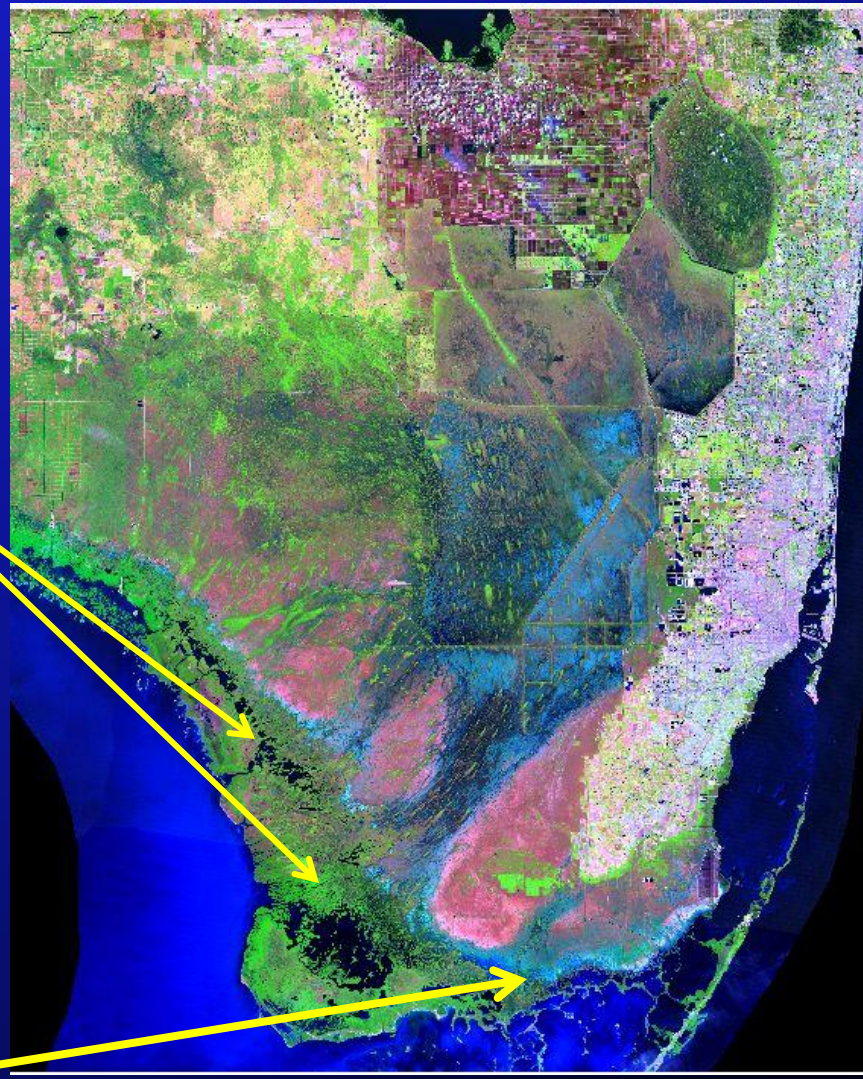
Summary of coastal wetland SET results: soil elevation changes slower than sea-level rise

Southwestern Everglades – change over 10 yrs



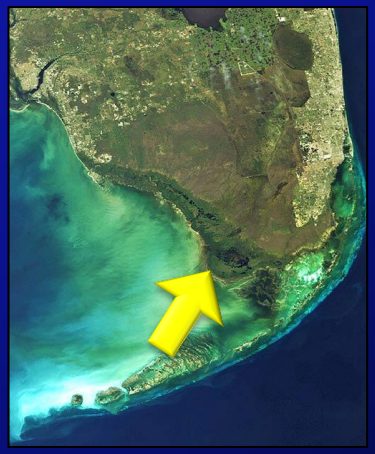
Southeastern Everglades - change over 11 yrs



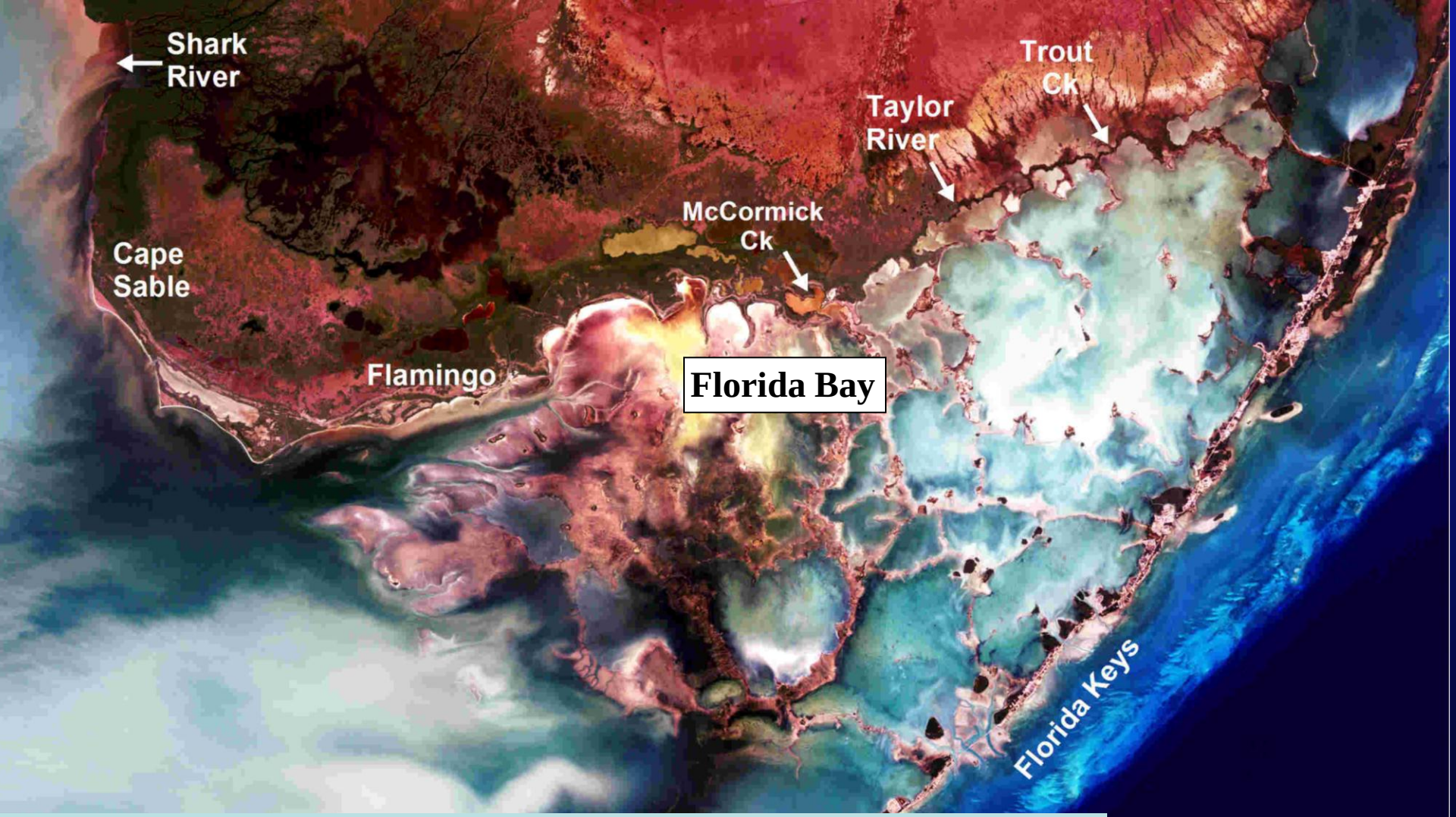


Rapid Marsh Elevation Loss on Cape Sable

Associated with saltwater intrusion from canals - an indicator of future peat collapse?



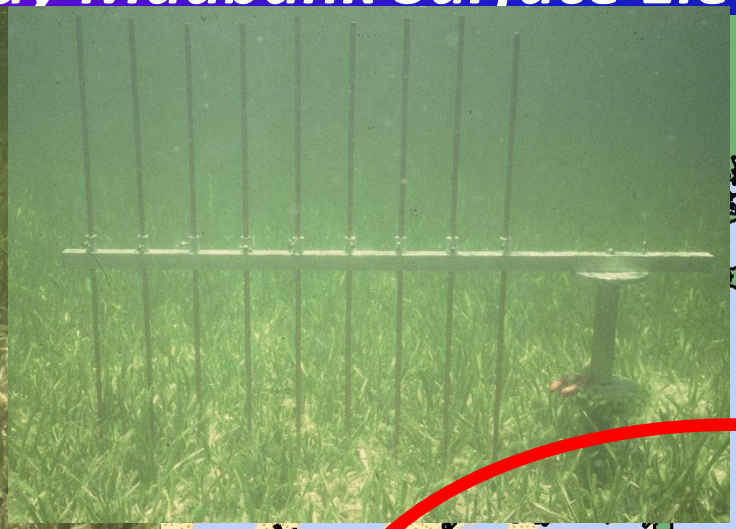
From H. Wanless



Florida Bay Biogenic Carbonate Mud Banks:

- **Restrict water exchange, dampen storm energy**
- **Influence salinity (hypersalinity to 70 psu)**
- **Increase nutrient retention**
- **Strong interaction with seagrass beds**

Florida Bay Mudbank Surface Elevation Tables



Russell Bank

Cross Bank

Bob Allen Bank

Nine Mile Bank

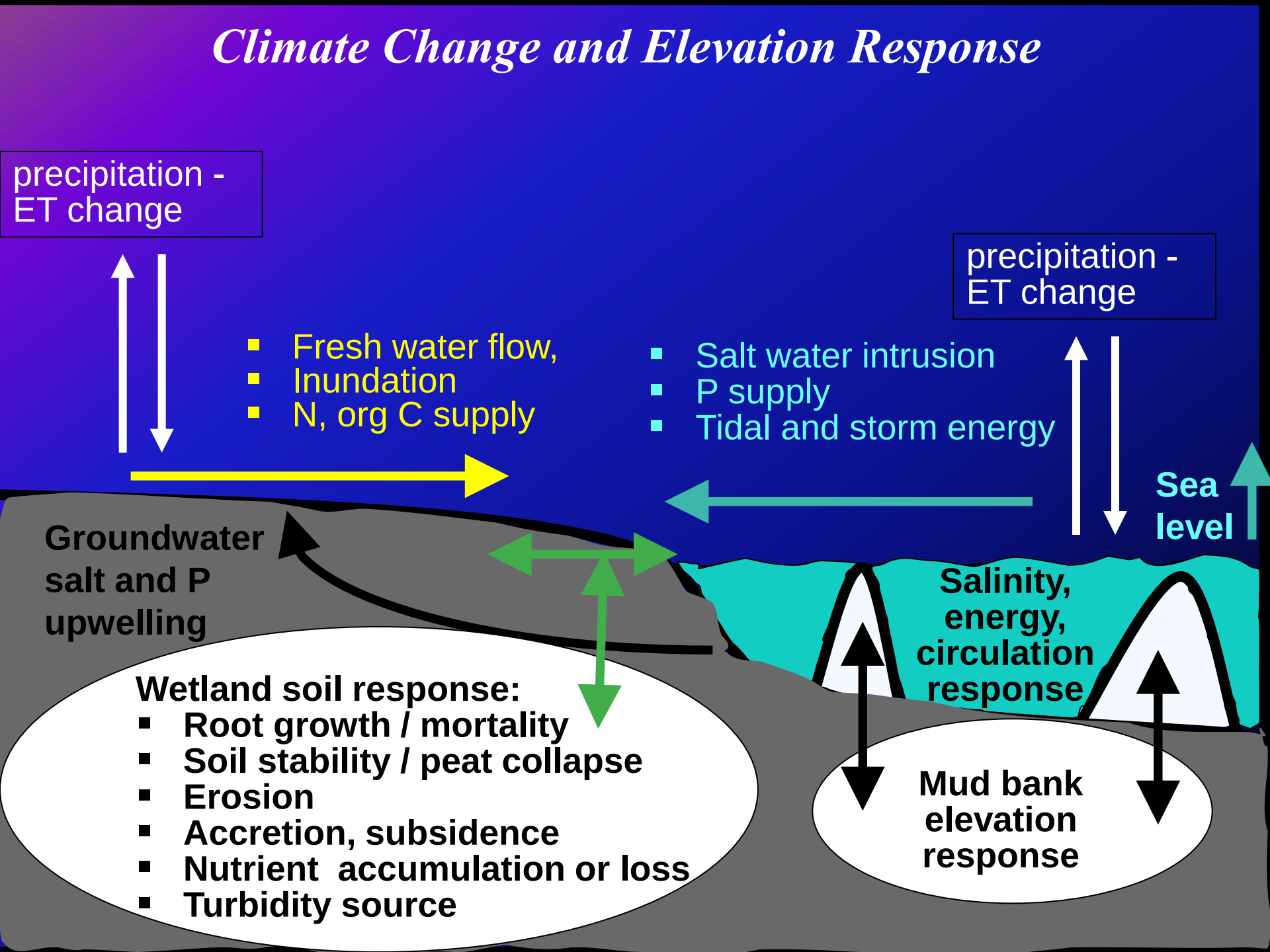
5 of 9 sites had increasing elevation (5-11 mm/y over 10 y period)

18 of 20 sites had decreasing elevation (10 y period)

From Robert Halley, USGS

Kilometers

0 2 4 8 12 16 20


Climate Change and Elevation Response
precipitation - ET change
Fresh water flow,
Inundation
N, org C supply
precipitation - ET change
Salt water intrusion
P supply
Tidal and storm energy
Sea level
Groundwater salt and P upwelling
Salinity, energy, circulation response
Wetland soil response:
Root growth / mortality
Soil stability / peat collapse
Erosion
Accretion, subsidence
Nutrient accumulation or loss
Turbidity source
Mud bank elevation response

Conclusion:

- Soil and mud bank elevation changes are slower than recent sea-level rise
- The state of future Everglades' wetland and estuarine systems can be influenced by restoration

Speculative forecast:

- Landscape will be shaped by oceanic energy, but modified by plant-soil response to sea-level rise and restoration
- Marine P will increase productivity
- Estuarine systems will expand, still with dependence on freshwater flow.

Scott Nixon

With sorrow, respect and thanks to two friends and mentors

John Ogden