SOUTH FLORIDA WATER MANAGEMENT DISTRICT

2015 Greater Everglades Ecosystem Restoration Conference
April, 21-23, 2015

DETERMINING HISTORICAL AND RECENT EVERGLADES PEAT QUANTITIES USING GEOSPATIAL TECHNIQUES

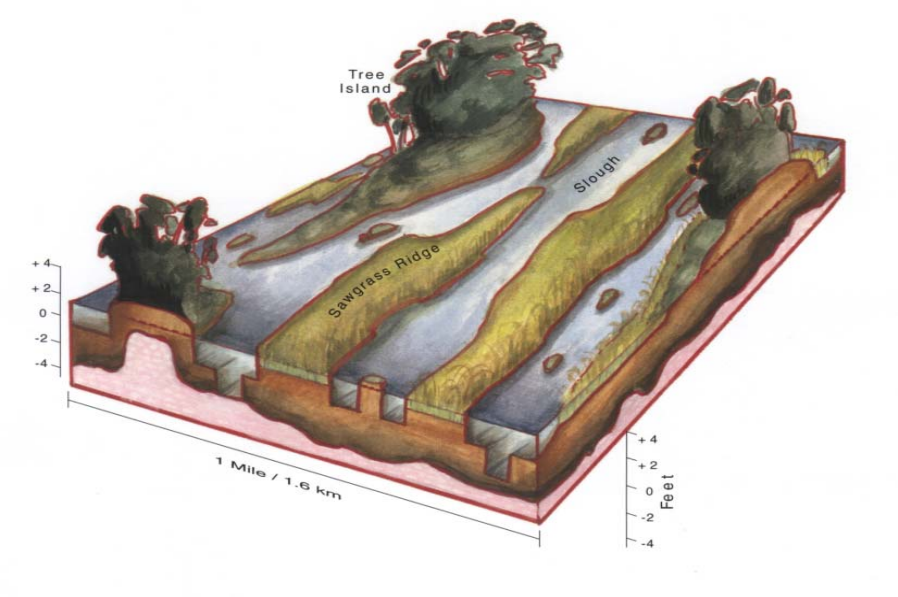
Thomas W. Dreschel, Section Leader
& Susan M. Hohner, Sr. Geographer
Everglades System Assessment
Applied Sciences Bureau

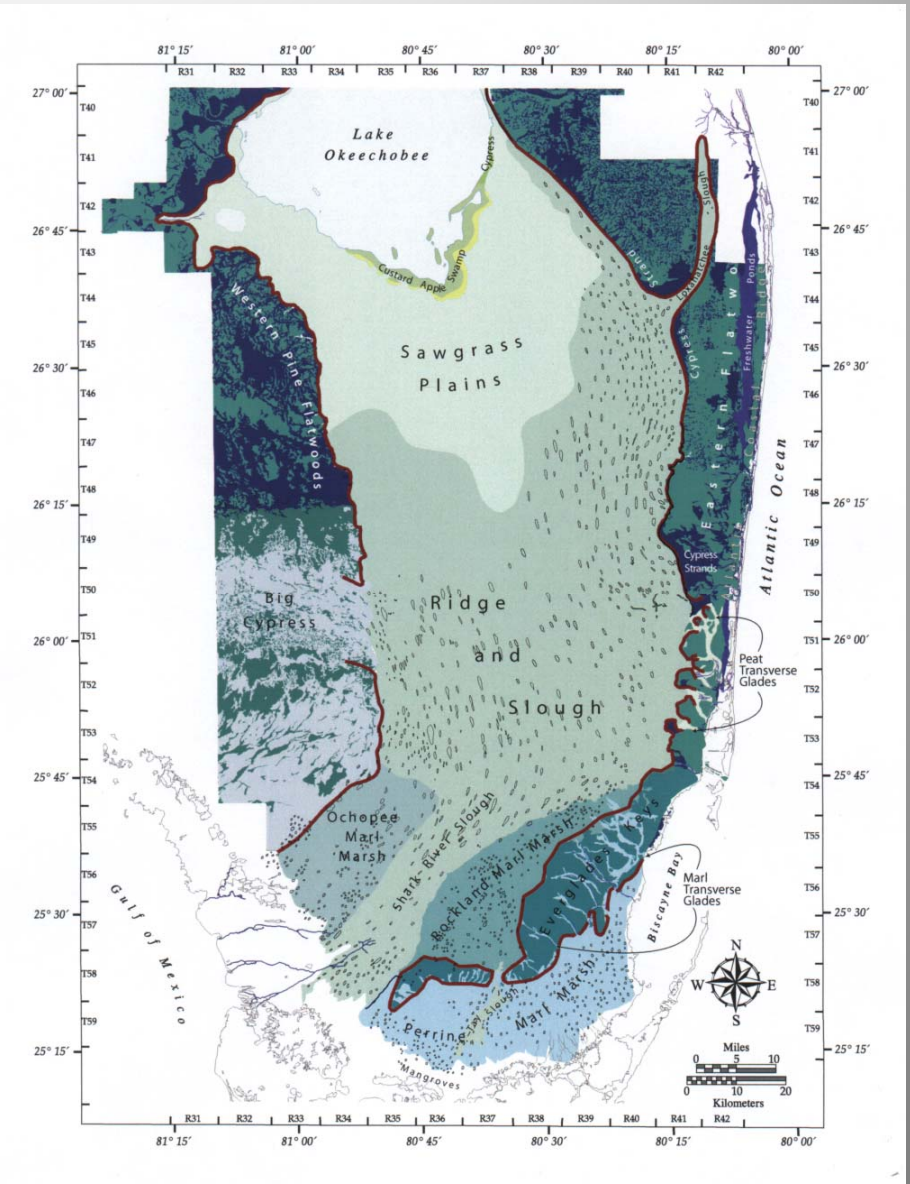
Everglades Landscapes: Then

Landscape

- A mixture of custard apple swamp forest, sawgrass plains, ridge and slough, marl marshes

McVoy *et al.* 2011





Everglades Landscapes: Now

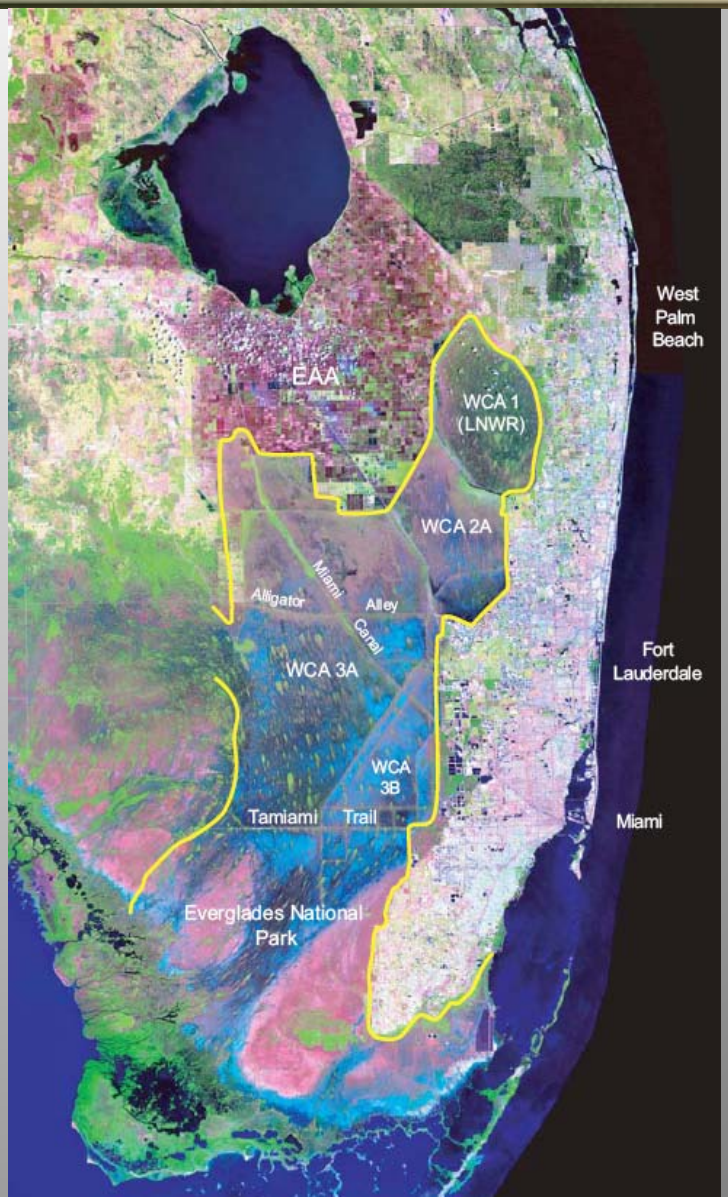
Landscape:

(What habitat remains of the predrainage Everglades footprint, now know as the Everglades Protection Area or EPA)

- Water Conservation Areas
- Everglades National Park

(What is no longer marsh habitat within the Everglades footprint)

- Eastern Bordering Urban Areas
- Everglades Agricultural Area

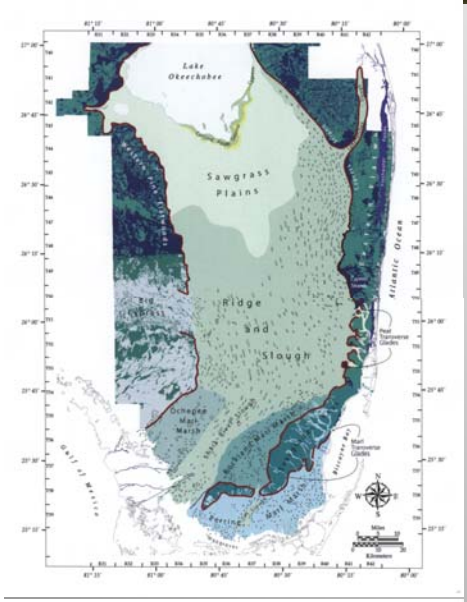


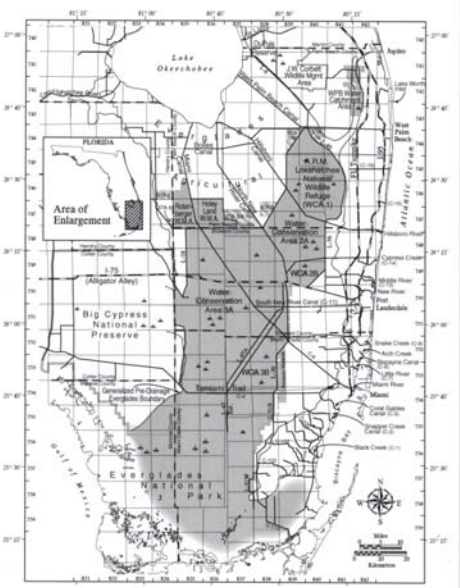
Everglades Landscape Change

Landscape	Ca. 1850 (m^2)	Ca. 2005 (m^2)	Percent remaining
Custard Apple Swamp	1.4×10^8	0	0
Sawgrass Plains	2.7×10^9	1.7×10^8	6
Ridge and Slough	6.1×10^9	2.7×10^9	44
Degraded Ridge & Slough	--	1.7×10^9	28
Peat Trans. Glades	6.1×10^7	0	0
Rockland Marl Marsh	6.5×10^8	3.2×10^8	49
Degraded Rockland Marl Marsh	--	8.9×10^7	14
Marl Trans. Glades	6.9×10^7	4.0×10^6	6
Perrine Marl Marsh	8.9×10^8	6.5×10^8	73
Ochopee Marl Marsh	5.7×10^8	5.7×10^8	100
Total	1.1×10^{10}	6.2×10^9	56

From Table 4.2 in Landscapes and Hydrology of the Predrainage Everglades, 2011.

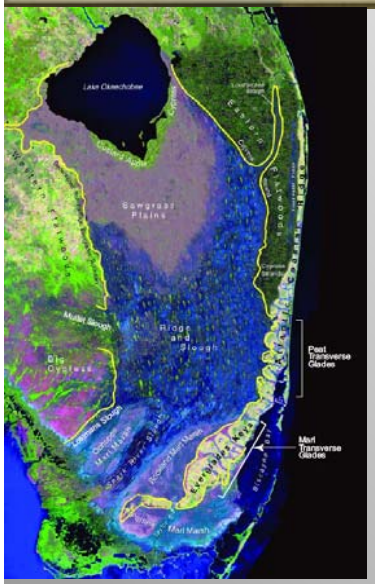
Everglades Peat Determination





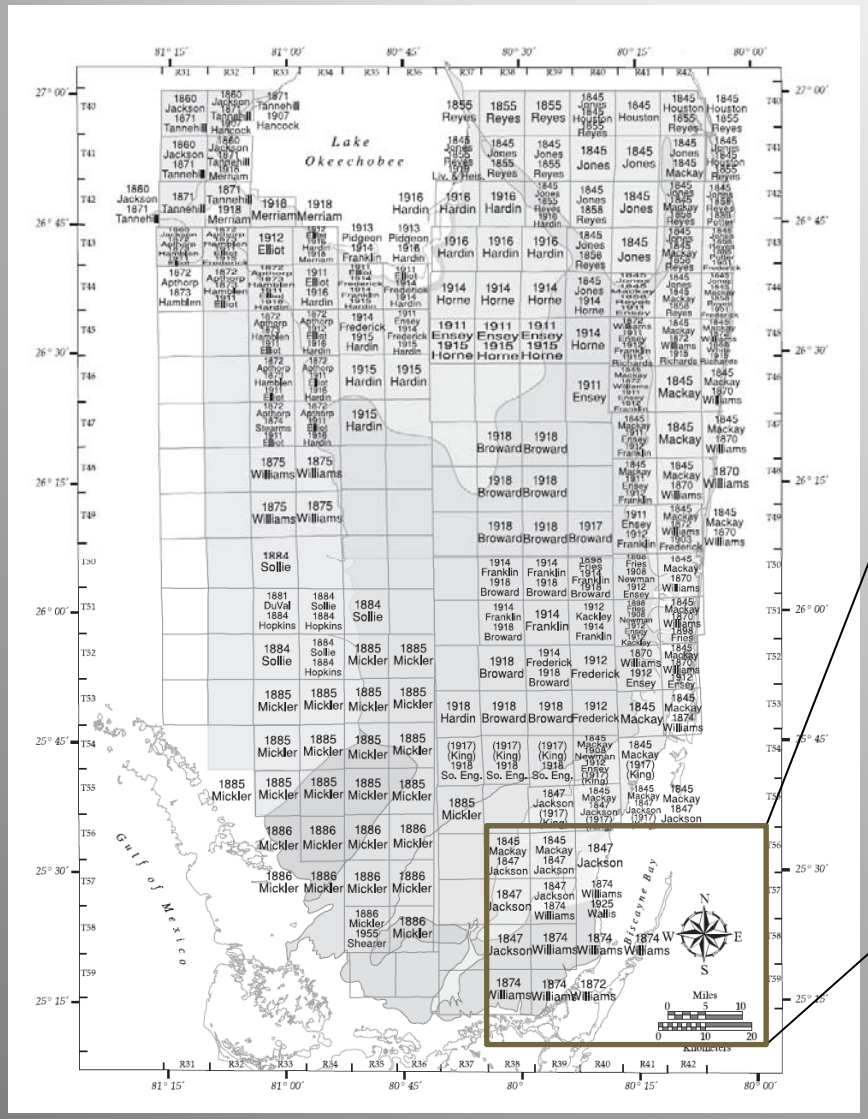
- **Peat provides an organic substrate for plant growth, a habitat for Everglades fauna plus it is a sink for carbon and serves to retain water.**
- **The purpose of this exercise was to determine:**
  - **Predrainage and current peat volumes**
  - **Predrainage and current peat masses**
  - **Predrainage and current peat carbon contents**
  - **Predrainage and current peat water retention capacity**
- **The scope:**
  - **Predrainage = mid 1800s**
  - **Current Everglades (Everglades Protection Area or EPA) = WCAs and ENP**
  - **Everglades Agricultural Area (EAA)**

Everglades Peat Determination

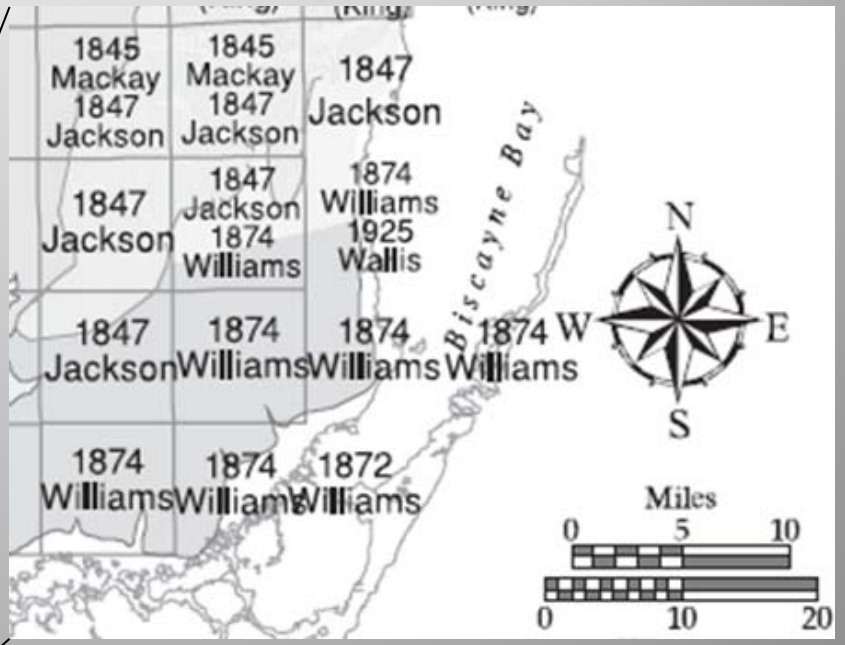


- **The approach:**
  - **Utilize Spatial Data Sets:**
    - **Predrainage surface elevations**
    - **Current surface elevations**
    - **Bedrock Elevations**
    - **Soil bulk density and carbon from R-EMAP**
  - **Create rasters from each data set;**
  - **“Cookie-cut” pertinent regions in each raster;**
  - **Determine volumes from bedrock elevations subtracted from surface elevations;**
  - **Calculate mass and carbon from volumes and soils characteristics (carbon and water retention).**

Data Sets for Evaluating Peat Volumes

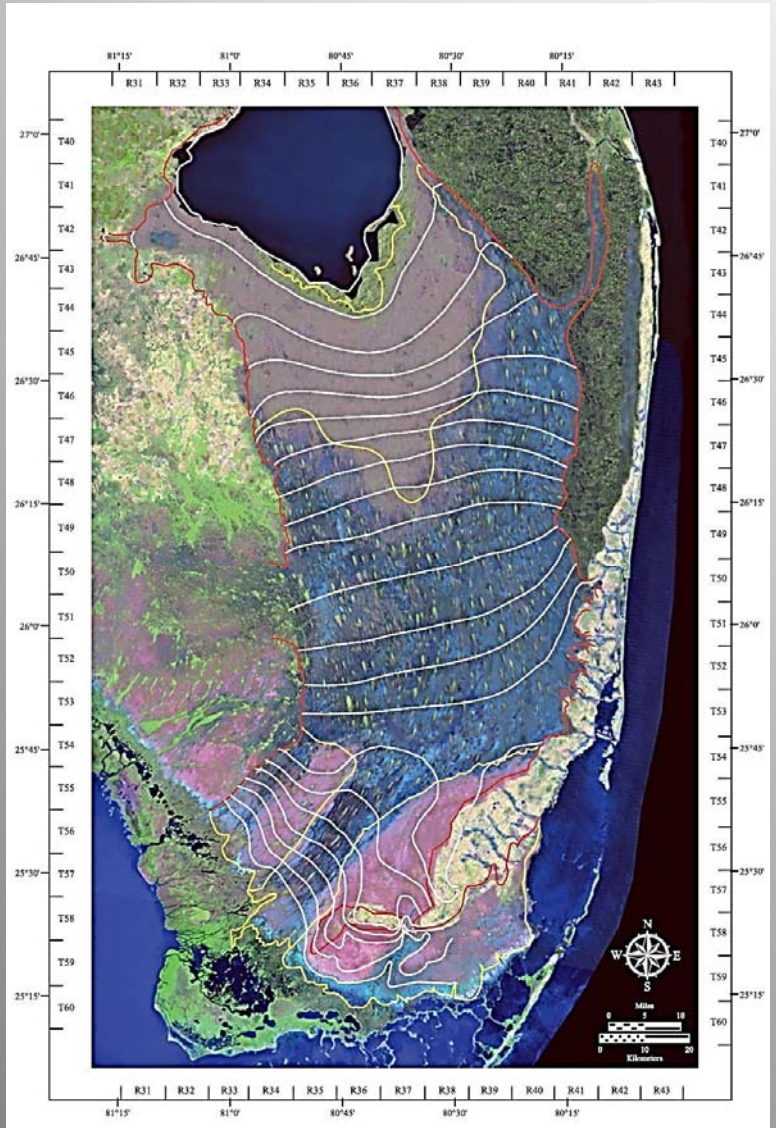


Surveys Used to Hindcast the Predrainage Contours

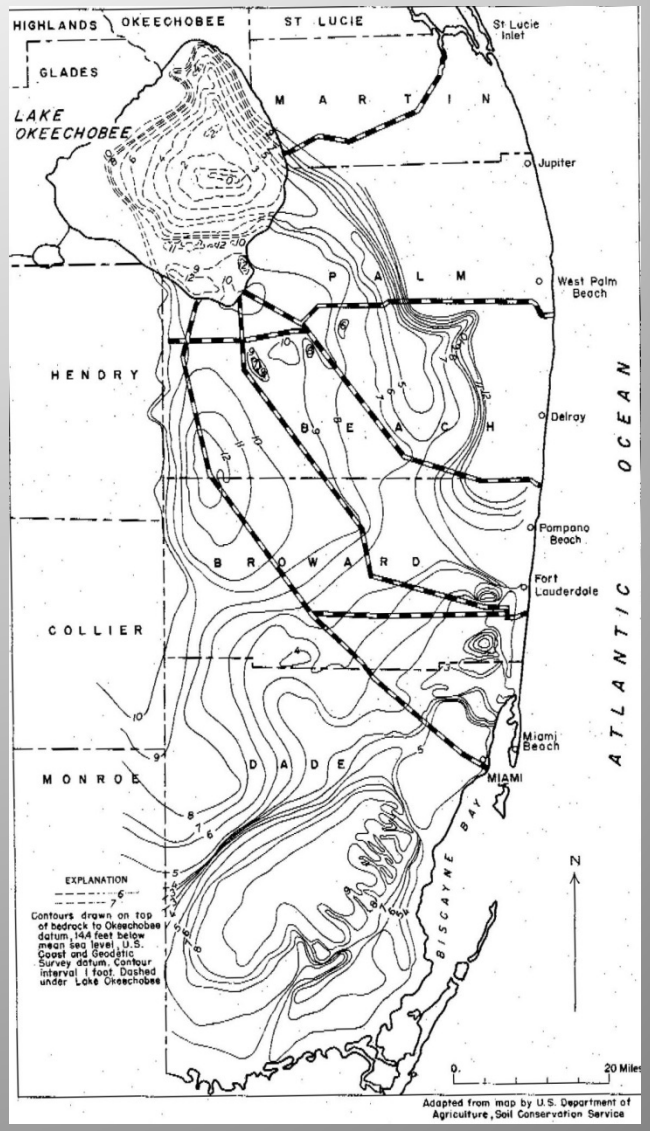


Data Sets for Evaluating Peat Volumes

Predrainage Contours from The NSRSM

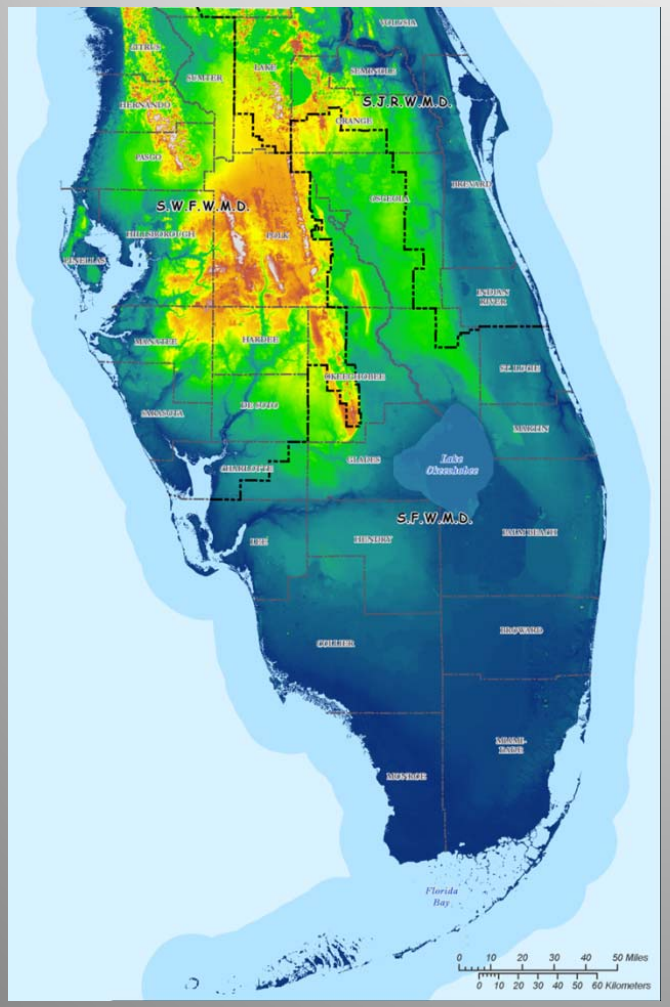


Everglades Bedrock Map from Parker et al., 1955.

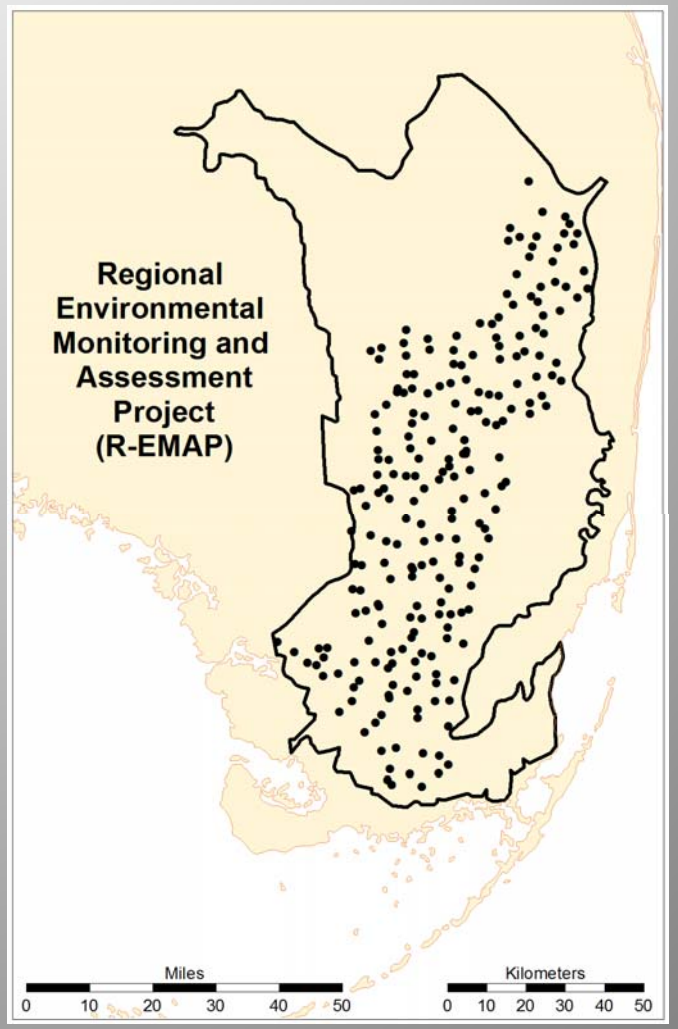


Data Sets for Evaluating Peat Content

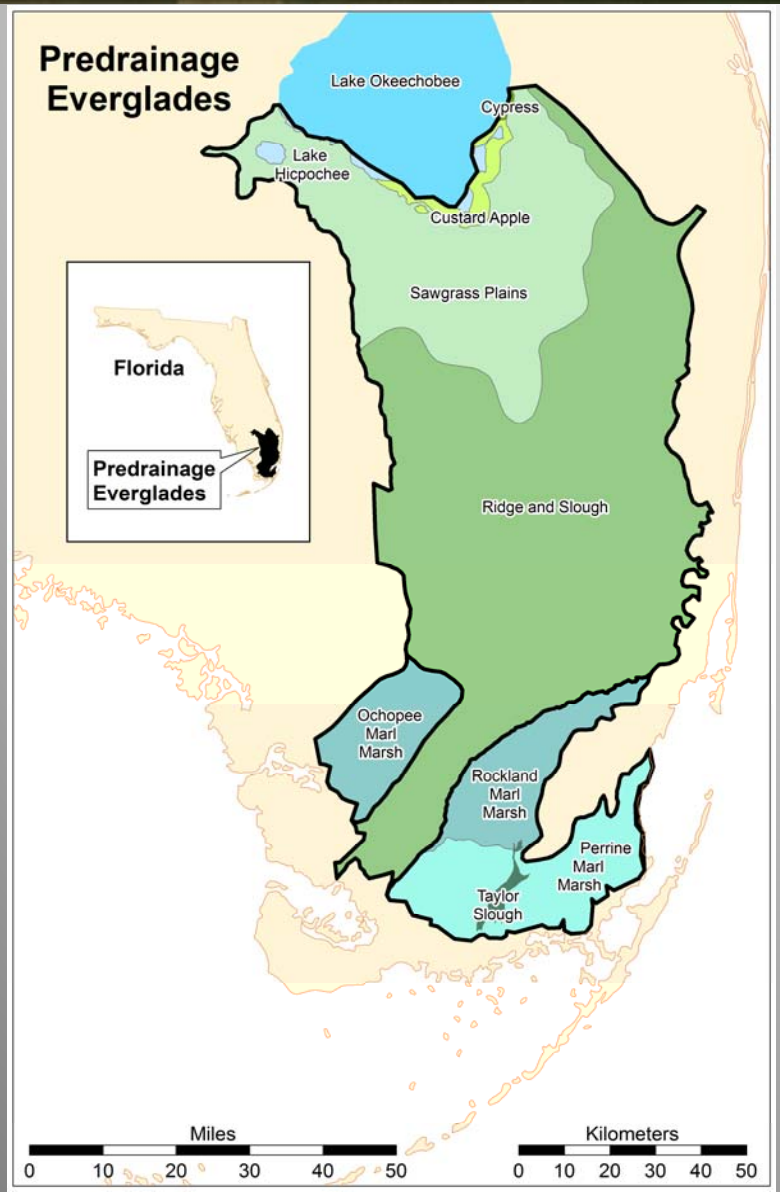
South Florida Topography Project –
South Florida Digital Elevation Model

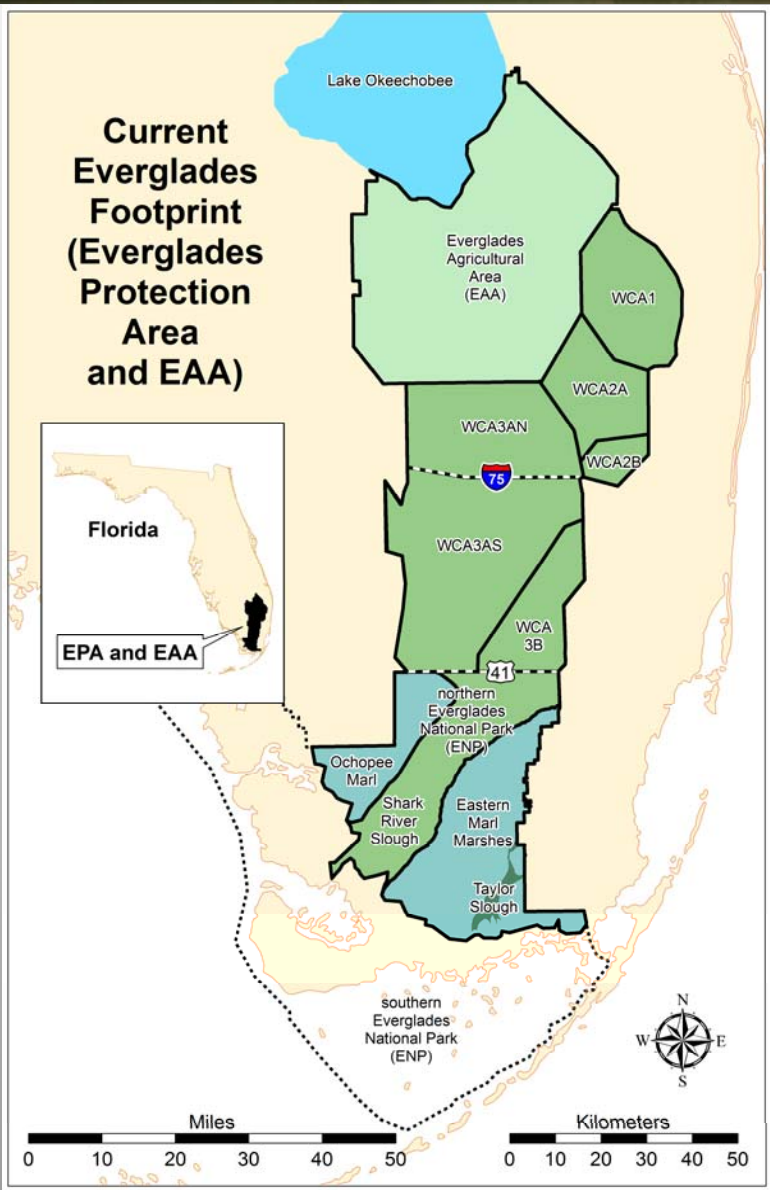


R-EMAP (EPA) Soils Data



The Predrainage vs. Current





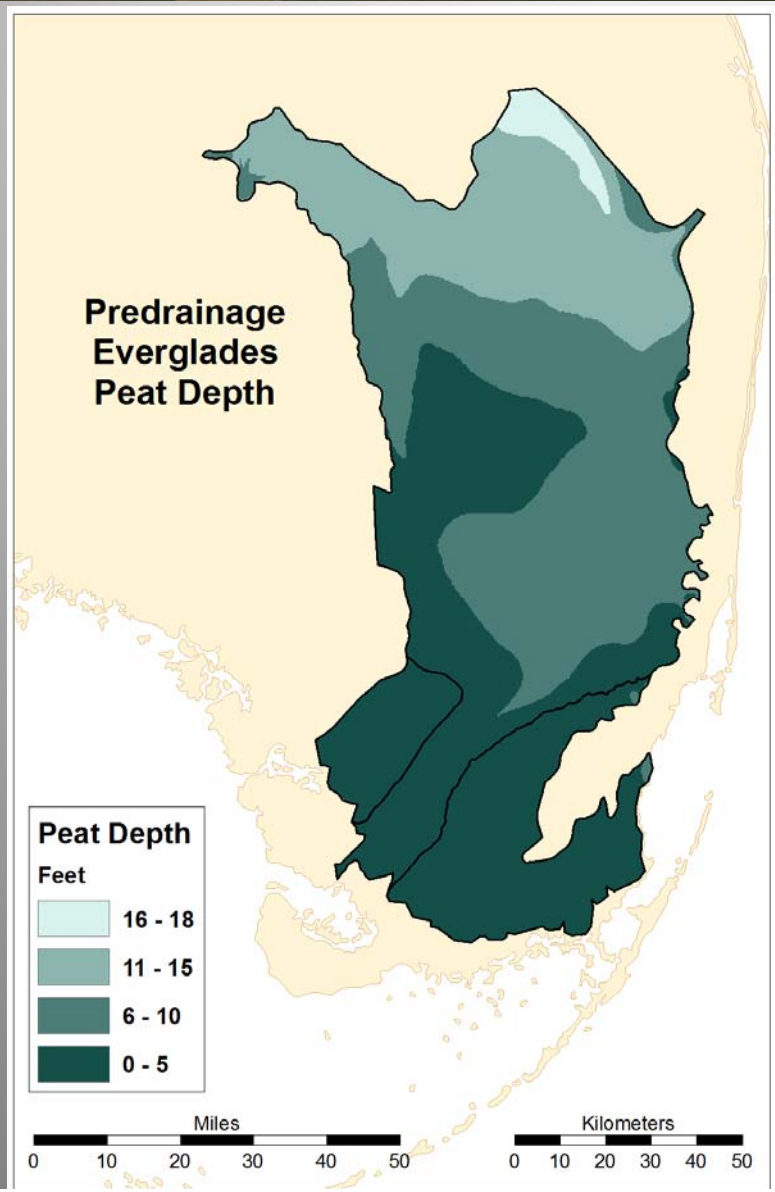
Procedures and Calculations

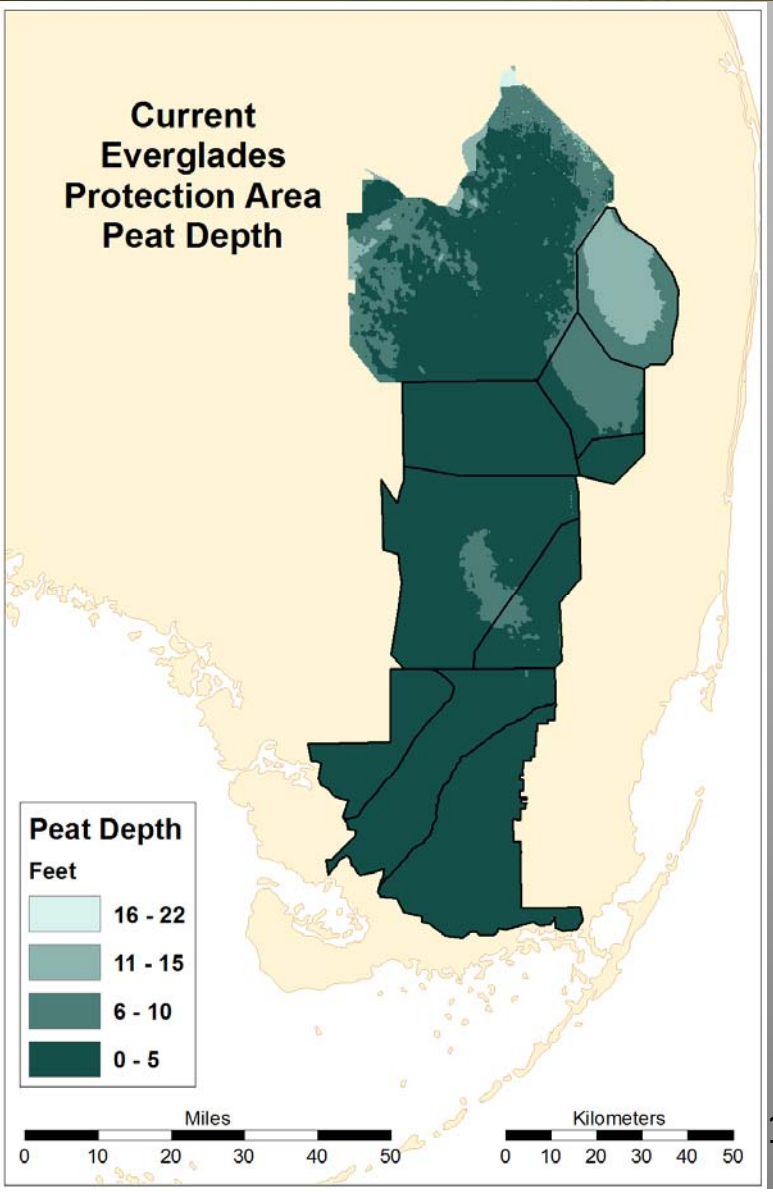
- **Everglades peat volumes = predrainage and current surface elevations (feet, NGVD) for each region minus the bedrock surface elevations (feet, NGVD) then converted to cubic meters**
- **Masses (megagrams) = peat bulk density (megagrams per cubic meter) times the volumes for the region**
- **Carbon (megagrams) = peat mass times carbon content (megagrams carbon per megagram of peat) for the region**

Processes and Sources of Error

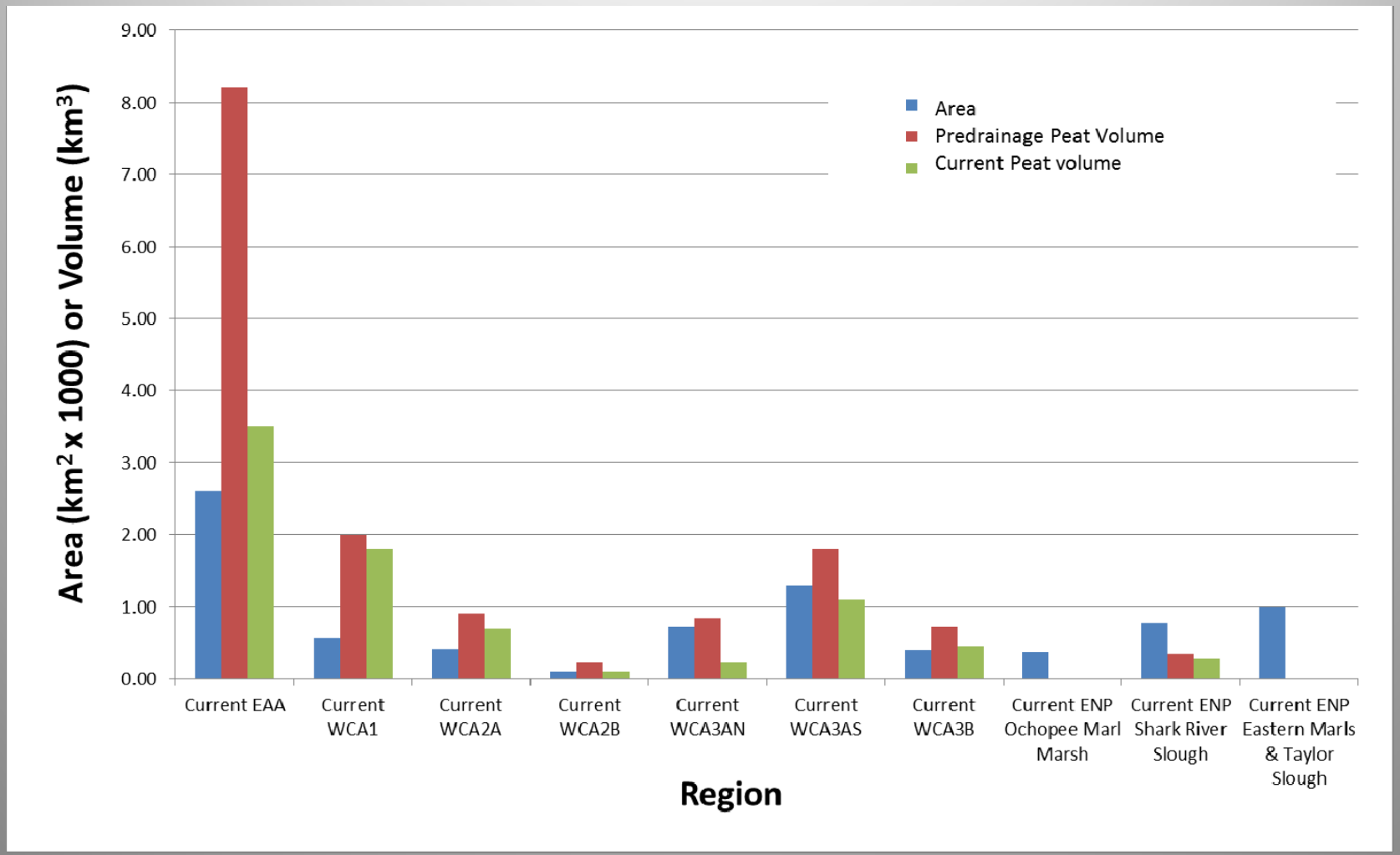
- **Predrainage surface = land surveys and canal construction surveys**
- **Current surface = a mosaic of data from sources having varying degrees of accuracy (LiDAR, bathymetry, surveys, etc.)**
- **The Parker bedrock map is referenced to earlier works, (Sanford, 1909; Fenneman, 1938; Jones et al., 1948) but no measure of accuracy is presented**
- **We used current EPA peat soils characteristics for both the current and predrainage calculations**
- **For the predrainage calculations, we screened the data and restricted it to values that were reasonable for predrainage peat, using the most unimpacted peat in the region (from WCA-1) as a proxy for predrainage**
- **Spatially interpolated data**

Everglades Peat Depths





Area and Peat Volume by Region



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

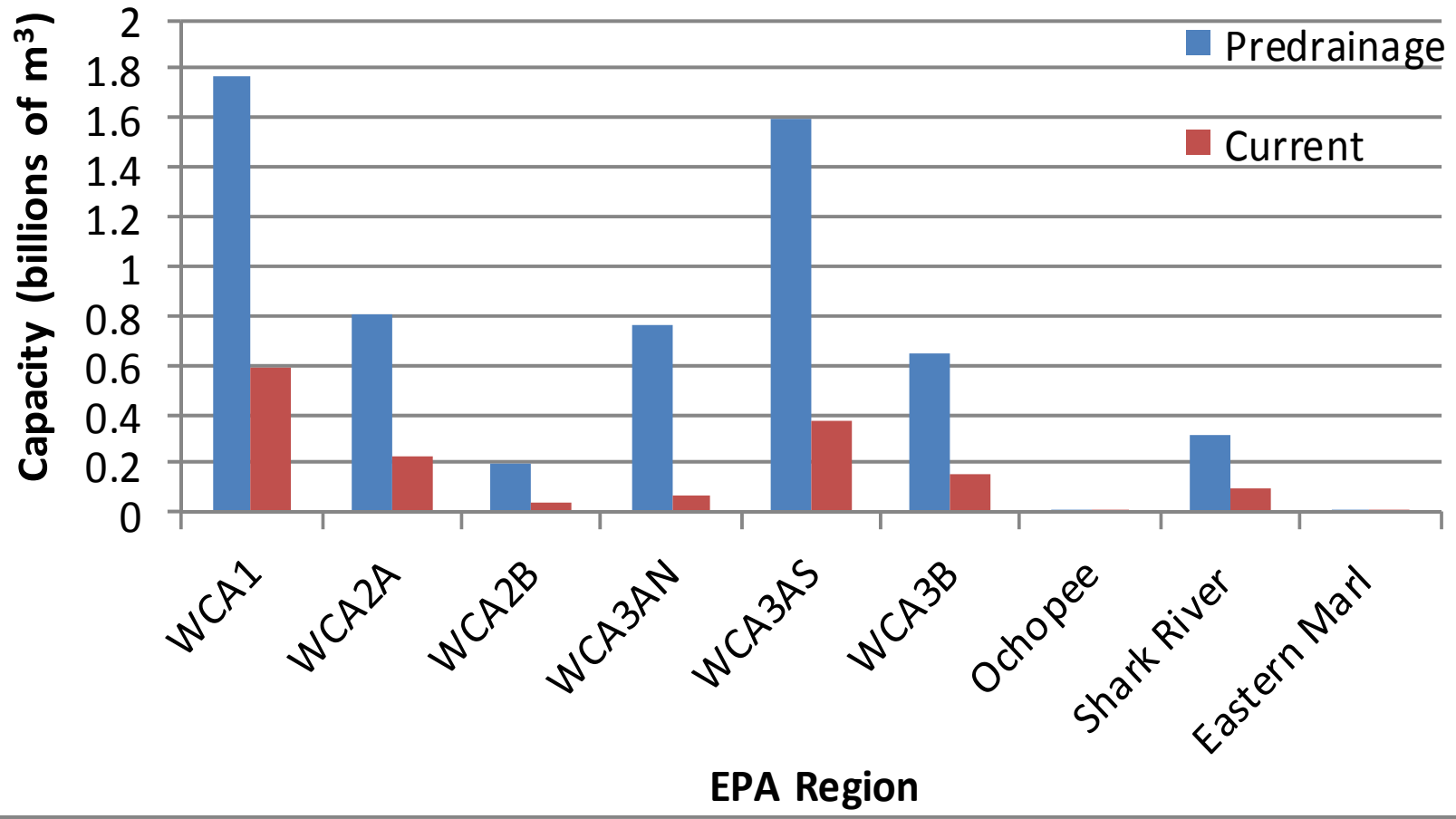
Peat Volumes Change by Region

Region	Original Volume (m^3)	Current Volume (m^3)	Volume Lost (m^3)	Percent of Original Volume
EAA	8.3×10^9	3.5×10^9	4.8×10^9	42
WCA1	2.0×10^9	1.8×10^9	2.2×10^8	89
WCA2A	9.1×10^8	6.9×10^8	2.2×10^8	76
WCA2B	2.2×10^8	1.1×10^8	1.0×10^8	53
WCA3AN	8.5×10^8	2.2×10^8	6.4×10^8	25
WCA3AS	1.8×10^9	1.1×10^9	6.8×10^8	62
WCA3B	7.2×10^8	4.6×10^8	2.6×10^8	64
ENP Ochopee Marl Marsh	6.9×10^6	9.2×10^6	$2.3x\ 10^6$ (gain)	134
ENP Shark River Slough	3.5×10^8	2.8×10^8	6.9×10^7	80
ENP Eastern Marls & Taylor Slough	1.4×10^7	1.2×10^7	1.4×10^6	90
Total EPA+EAA	1.5×10^{10}	8.2×10^9	7.0×10^9	54
Total EPA	6.8×10^9	4.7×10^9	2.2×10^9	69

Predrainage, Current and Difference

Landscape/ Project	Peat Area (km^2)	Peat Volume (m^3)	Mass (Mg)	Carbon (Mg)
Predrainage Everglades	1.1×10^4	2.0×10^{10}	2.6×10^9	9.4×10^8
Current Everglades Protection Area	5.6×10^3	4.7×10^9	4.5×10^8	1.8×10^8
Change (Loss)	5.4×10^3	1.5×10^{10}	2.2×10^9	7.6×10^8

Estimated Water Retention Capacity



Estimated Water Retention Capacity

Landscape/ Project	Peat Volume (m^3)	Water Capacity (MT/m^3)	Water ($MT \sim m^3$)
Predrainage Everglades	2.0×10^{10}	0.890	1.8×10^{10}
Current Everglades Protection Area	4.7×10^{9}	0.334	1.6×10^{9}
Current WCA-3A and WCA-3B	1.8×10^{9}	0.334	6.0×10^{8}
Central Everglades Planning Project			2.6×10^{8} Additional Water Provided

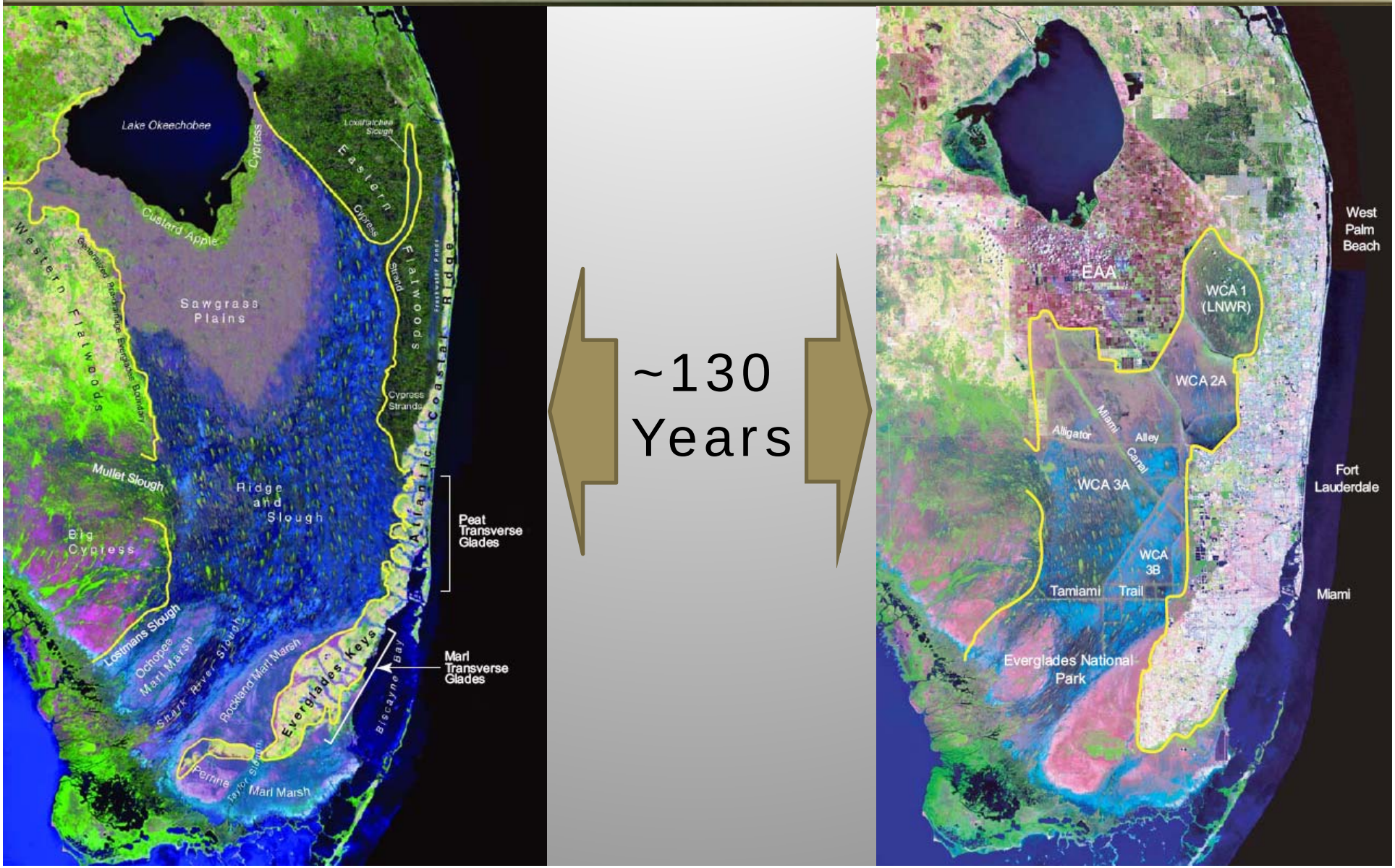
Conclusions

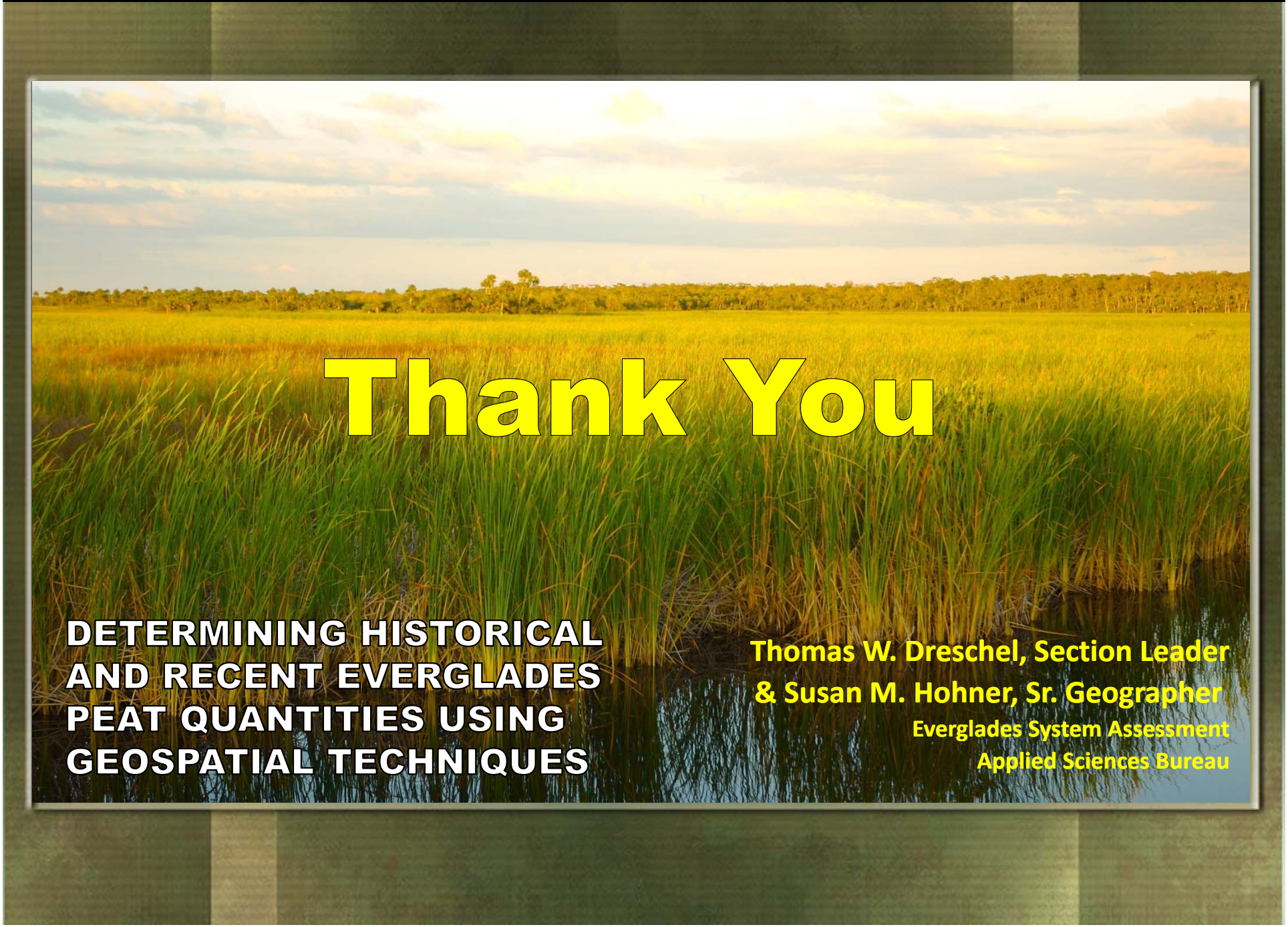
- **Predrainage Everglades area = 11 billion m^2; peat volume = 20 billion m^3 and mass = 2.6 billion metric tons**
- **Current Everglades area = 5.6 billion m^2; peat volume = 4.7 billion m^3 and mass = 440 million metric tons**
- **Predrainage Everglades = 940 million metric tons of carbon; average depth of peat of about 2 meters**
- **Current Everglades Protection Area = 180 million metric tons of carbon; average depth of peat of about ¾ of a meter**
- **Current Everglades = one-half of the area, less than one-fourth of the volume, one-fifth the mass and carbon of the predrainage Everglades**
- **The Central Everglades Planning Project, an accelerated project of CERP, will provide additional water equal to about 1/3 of that needed to fully hydrate WCA-3A and WCA-3B**

Sources:

- Aich, S. and T. W. Dreschel. 2011. Evaluating Everglades Peat Carbon Loss Using Geospatial Techniques. *Florida Scientist* 74(1):63-71.
- Aich, S., C.W. McVoy, T.W. Dreschel and F. Santamaria. 2013. Estimating Soil Subsidence and Carbon Loss in the Everglades Agricultural Area, Florida using Geospatial Techniques. *Agriculture, Ecosystems & Environment* 171 (2013) 124-133.
- Aich, S., C. W. McVoy, F. Santamaria and T. W. Dreschel. 2008. Early Post-Drainage Aspects of the Everglades Agricultural Area Based on Historic Land and Canal Surveys. Poster presented at the 15th Annual South Florida GIS Expo, West Palm Beach, FL.
- Hohner, S. M., and T. W. Dreschel. 2015. Everglades peats: using historical and recent data to estimate predrainage and current volumes, masses, carbon contents and water retention capacities. *Mires and Peat* 16: Art. 1, 15 pp.
- Holt, P. R., R. J. Sutton and D. Vogler. 2006. *South Florida Digital Elevation Model, Version 1.1.* U. S. Army Corps of Engineers, Jacksonville District, Jacksonville, FL
- McVoy, Christopher W., Winifred Park Said, Jayantha Obeysekera, Joel A. VanArman and Thomas W. Dreschel. 2011. *Landscapes and Hydrology of the Predrainage Everglades.* University Press of Florida, Gainesville, FL. 342 pp. + 297 pp. on DVD.
- Parker G.G., Ferguson, G.E., Love, S.K., et al., 1955. *Water Resources of Southeastern Florida.* Geological Survey Water-Supply Paper 1255, United States Government Printing Office, Washington, DC.
- Said, W.P. and M. C. Brown. 2011. *Hydrologic Simulation of the Predrainage Greater Everglades Using the Natural System Regional Simulation Model v3.3.* South Florida Water Management District, Hydrologic and Environmental Systems Modeling Section, West Palm Beach, FL, 532 pp.

Questions or Comments?





DETERMINING HISTORICAL AND RECENT EVERGLADES PEAT QUANTITIES USING GEOSPATIAL TECHNIQUES

Thomas W. Dreschel, Section Leader
& Susan M. Hohner, Sr. Geographer
Everglades System Assessment
Applied Sciences Bureau