Landscape Scale Patterns of Significant Nutrients and Contaminants in the Greater Everglades Ecosystem: Past, Present and Future

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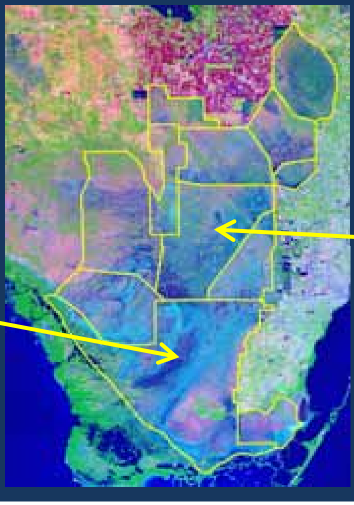
Presentation Objectives

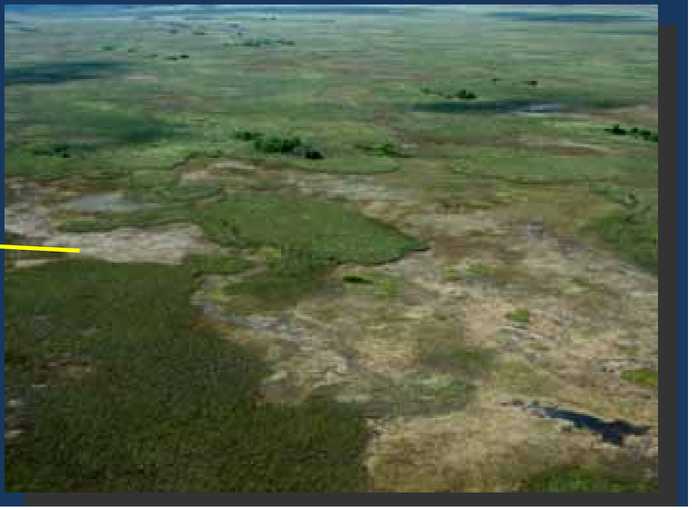
-Present selected landscape scale patterns of nutrients and contaminants

-Focus on P, S, and Hg in soils across the Greater Everglades Ecosystem

-Overview of recent landscape scale investigations and key findings

-Discuss challenges / decisions facing future landscape scale monitoring and assessment efforts





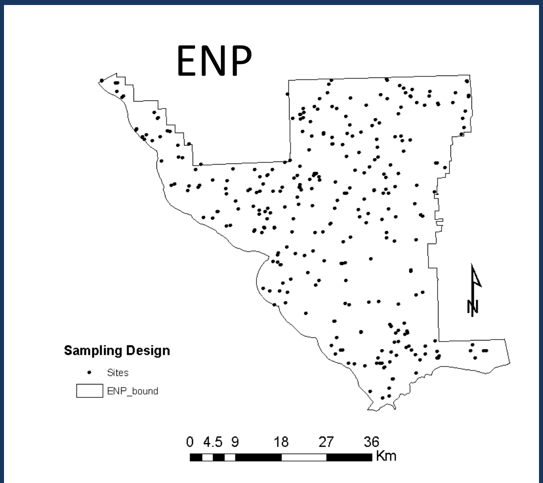
Rationale

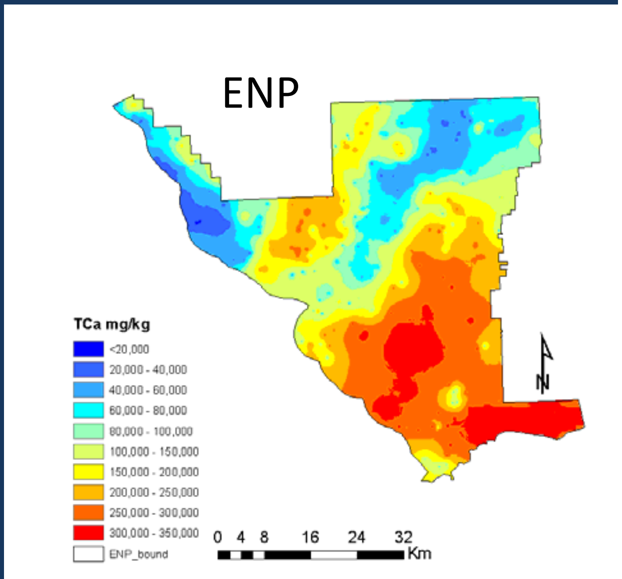
-Big picture perspective

-Identify regional impacts “hot spots” = areas of concern

-Identify trends at ecosystem scale

-Enable assessment of ecosystem restoration success via comparison to baseline condition

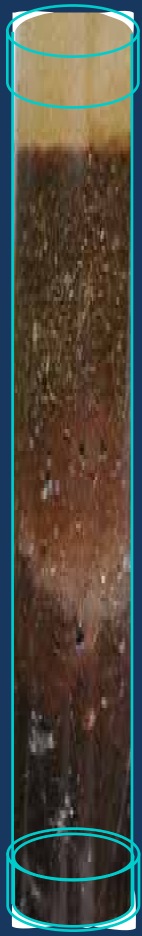




Why Soils?

CERP uses soil characteristics as indicators of restoration success

- Soils are an integrator of long-term water chemistry conditions (DeBusk et al. ‘94)
- Nutrient inputs to wetlands primarily stored in peat (Reddy et al. ‘92, Newman et al. ‘97)
- Spatial distribution of soil nutrients can be used to assess long-term nutrient impacts (Newman et al. ’97, Bruland et al. ‘06)
- Soils = ideal ecosystem component for assessing baseline status of GEE prior to CERP activities



Landscape Scale Monitoring and Assessment Efforts

Everglades Ecosystem Assessment: Regional Environmental Monitoring and Assessment Project (R-EMAP)

1993 – 2005

Probability based sampling design

Sites n= 1145 over 3 phases

soil, floc, water, porewater, vegetation, periphyton, fish, macroinvertebrates

Scheidt, D.J, and P.I. Kalla. 2007. Everglades ecosystem assessment: water management and quality, eutrophication, mercury contamination, soils and habitat: monitoring for adaptive management: a R-EMAP status report. USEPA Region 4, Athens, GA. EPA 904-R-07-001 98pp.

Everglades Soil Mapping Project (ESM)

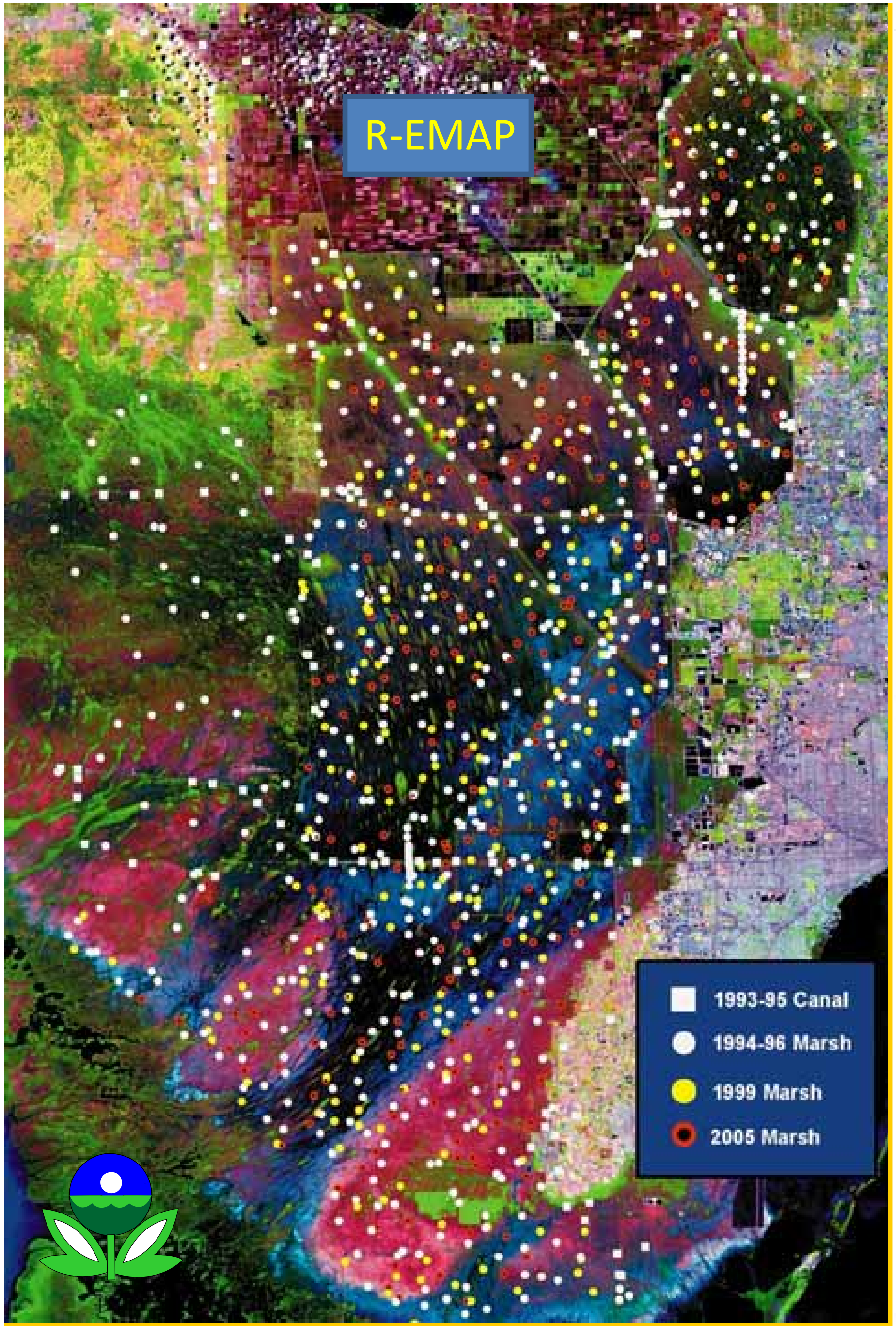
2003 – 2004

Stratified random sampling design

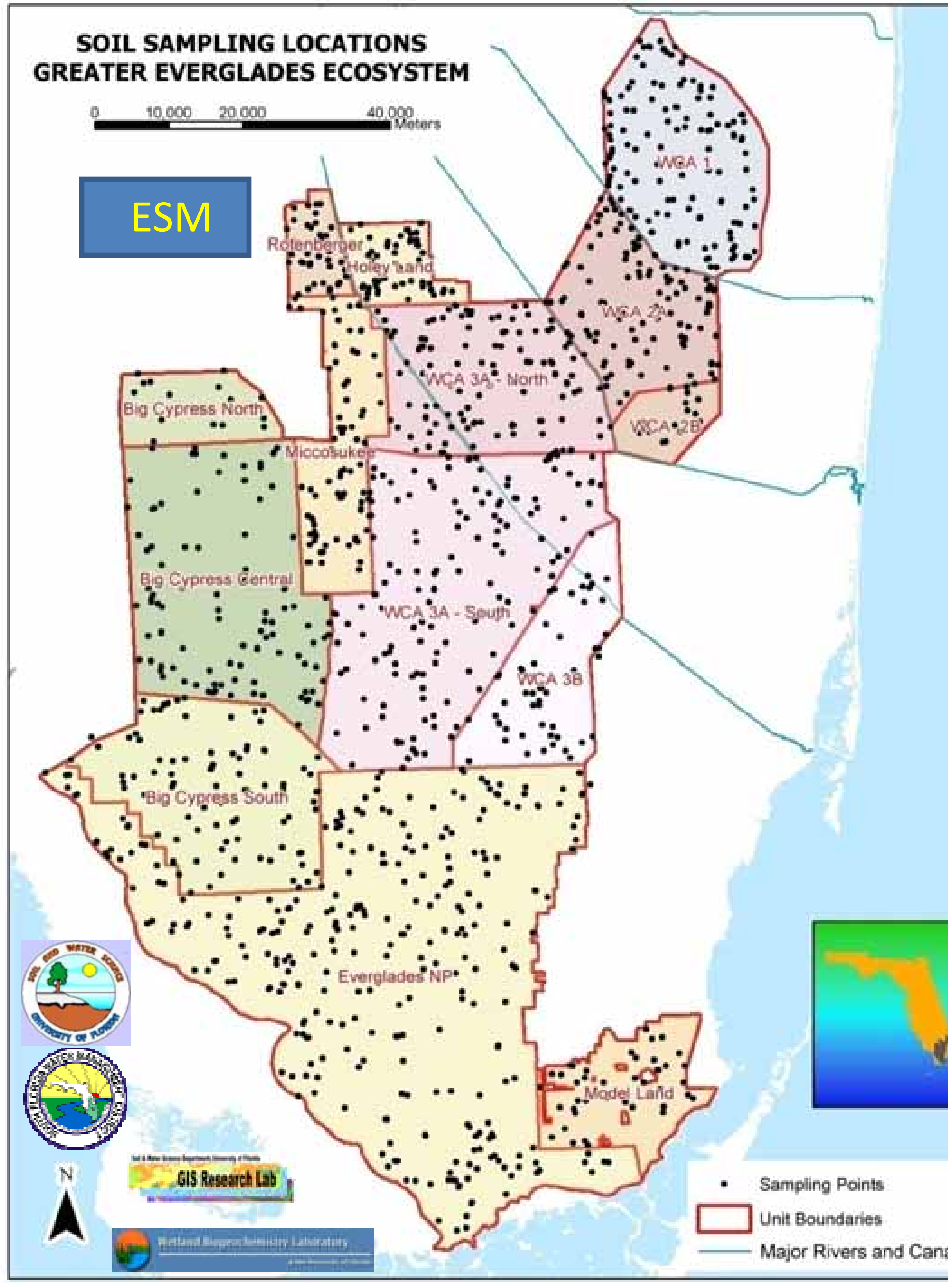
Sites n= 1358 1 phase

soil, floc, water, vegetation

Reddy, K.R., S. Newman, S. Grunwald, T.Z. Osborne, G.L. Bruland, R.G. Rivero, R. Corstanje. 2005. Everglades Soil Mapping Project. Final Report SFWMD



Scheidt & Kalla 2007



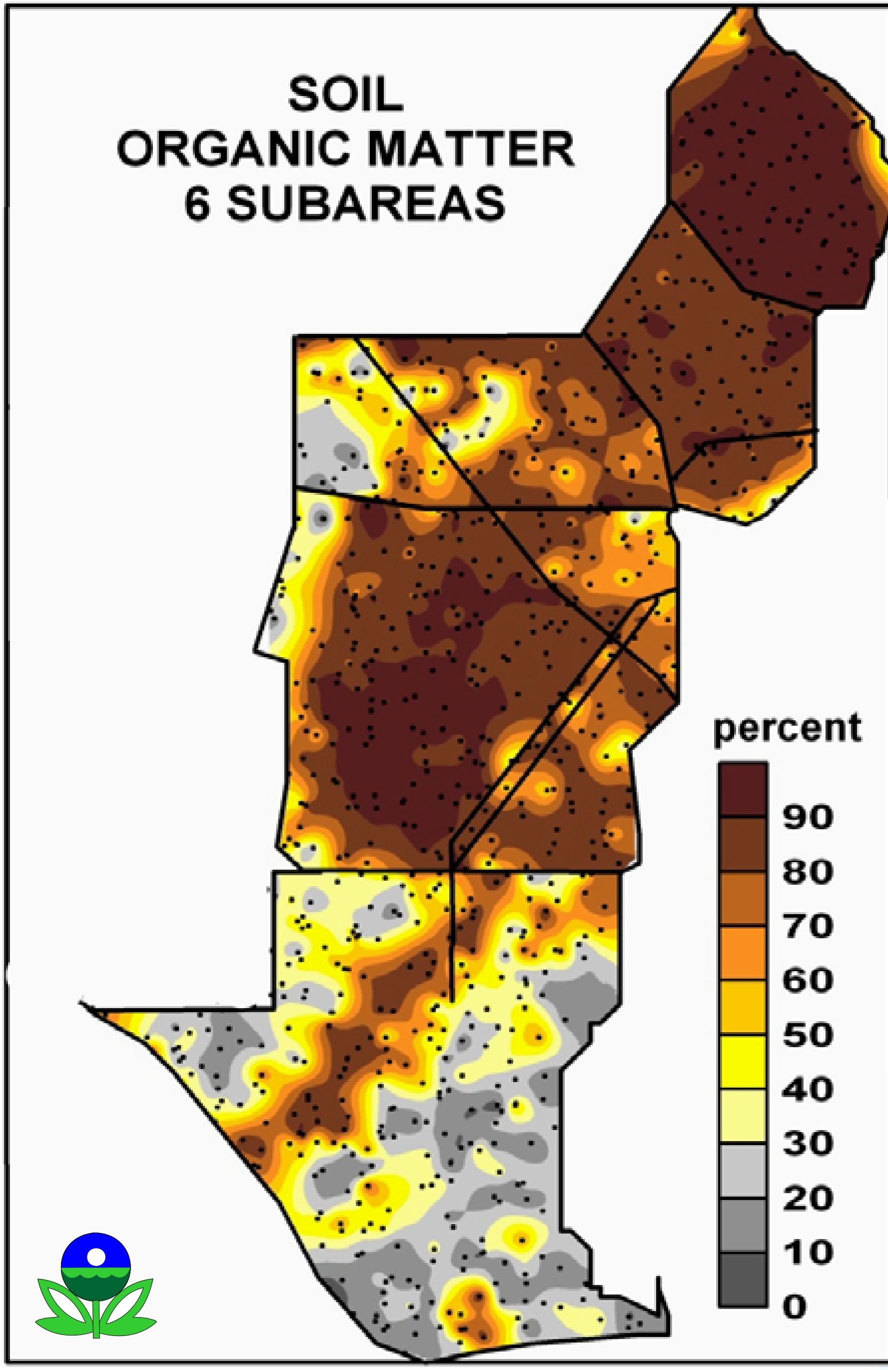
Reddy et al. 2005

R-EMAP Soil Parameters

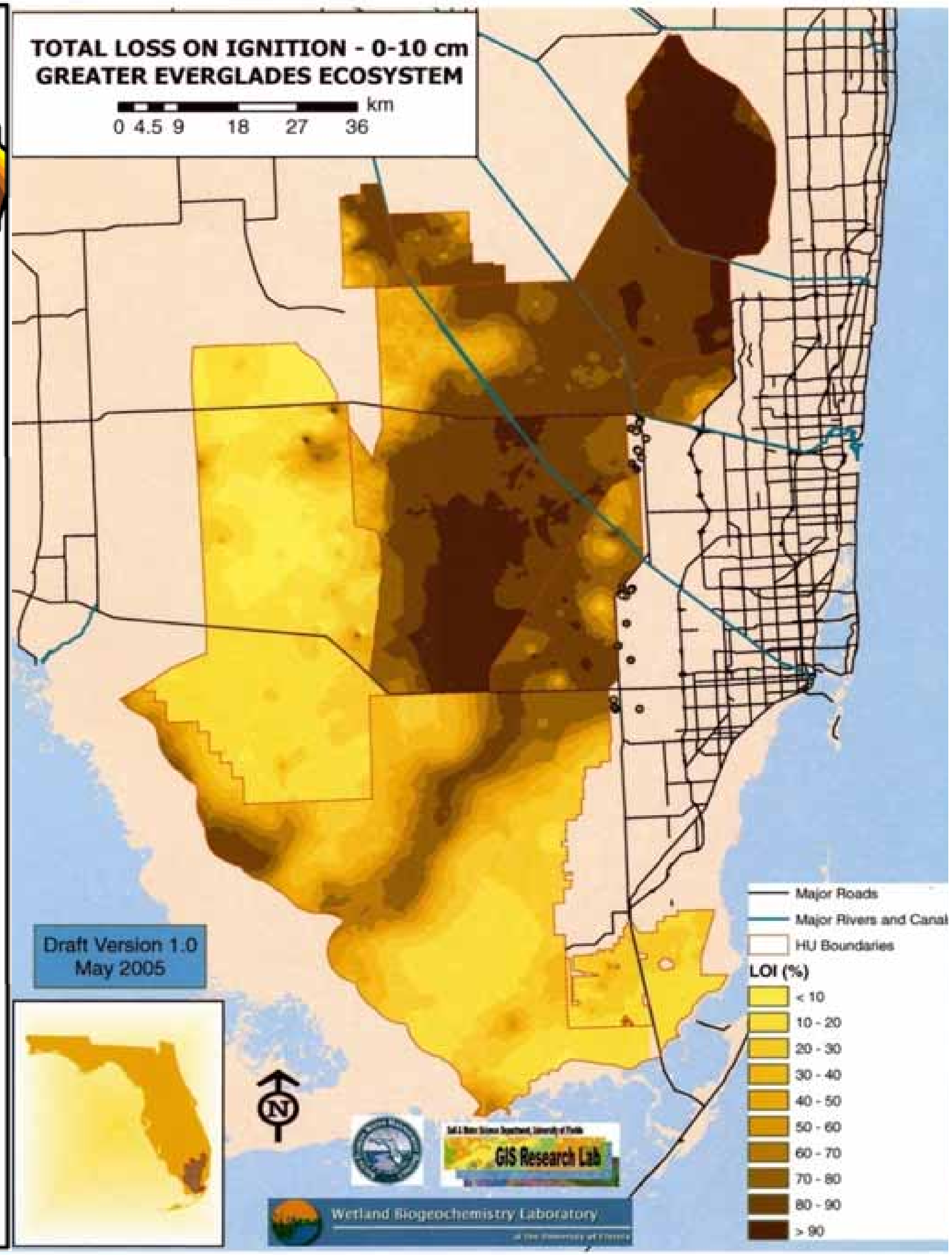
- Soil
  - Thickness, in-situ pH, in-situ redox, photodocumentation
  - 3 cores per site
  - Floc, periphyton mat, 0–10 cm soil separated for lab analyses.
  - TP, MeHg, THg, TN, TC, AVS, CH_4, CO_2
  - Bulk density, % Organic Matter
  - Mineral content,
- Floc
  - TP, TC, TN, THg, MeHg, Bulk density, % Organic Matter, thickness

ESM Soil Parameters

- Soil
  - 1 core per site (10% triplicates)
  - Floc, periphyton mat, 0–10 cm soil, 10-20 cm soil separated for lab analyses.
  - TP, TPi, TN, TC, TAl, TCa, TFe, TMg, TS, THg
  - Bulk density, % Organic Matter
- Floc
  - TP, TPi, TN, TC, TAl, TCa, TFe, TMg, TS, THg
  - BD, LOI, Thickness

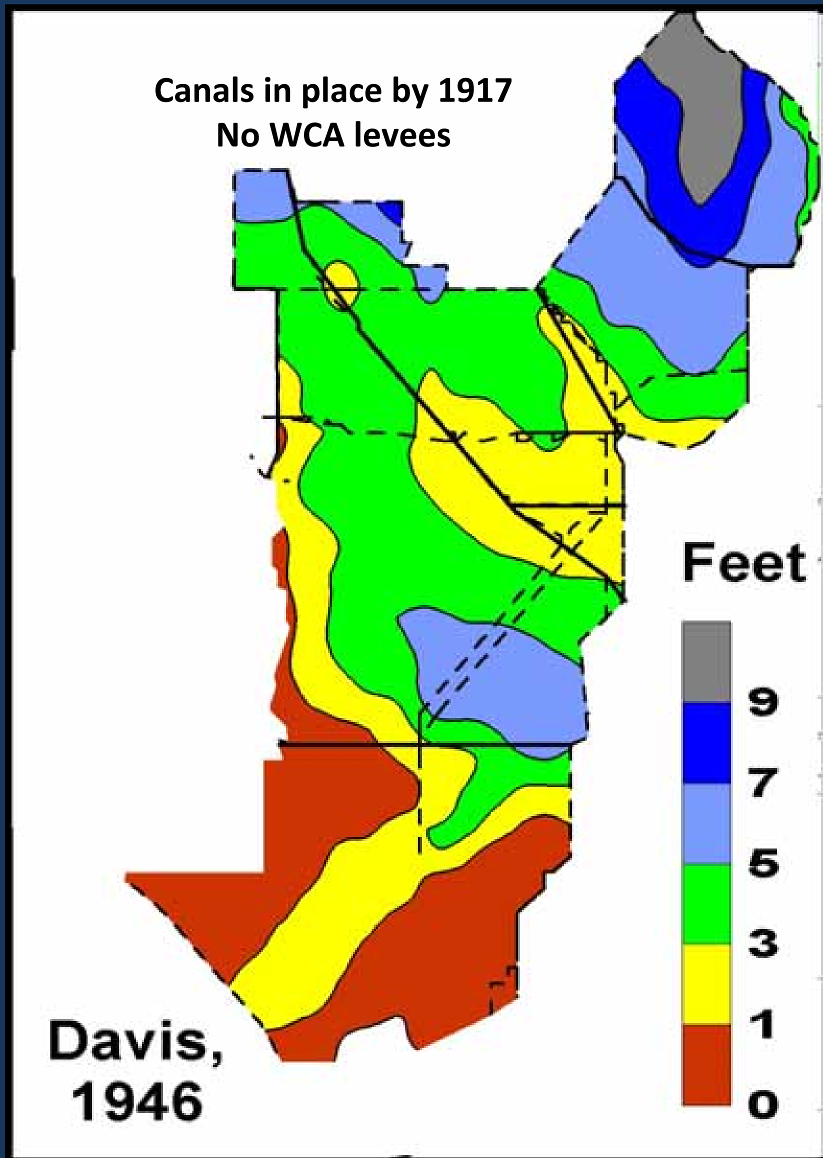


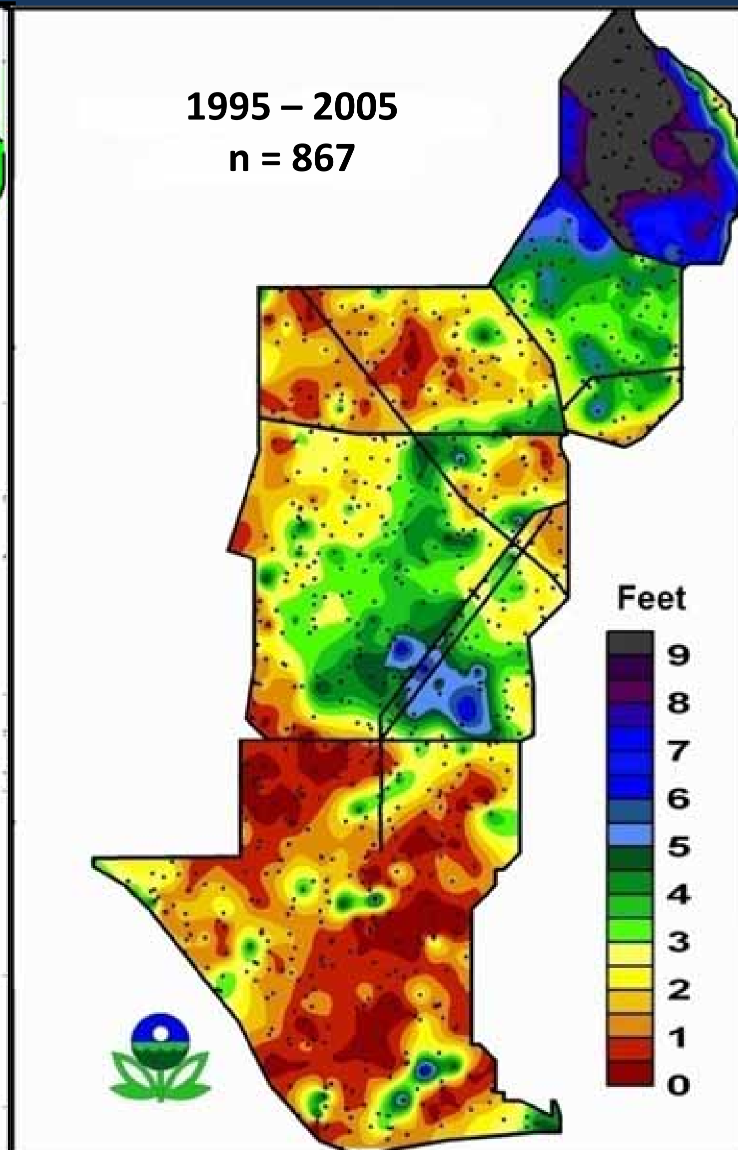
Scheidt & Kalla 2007



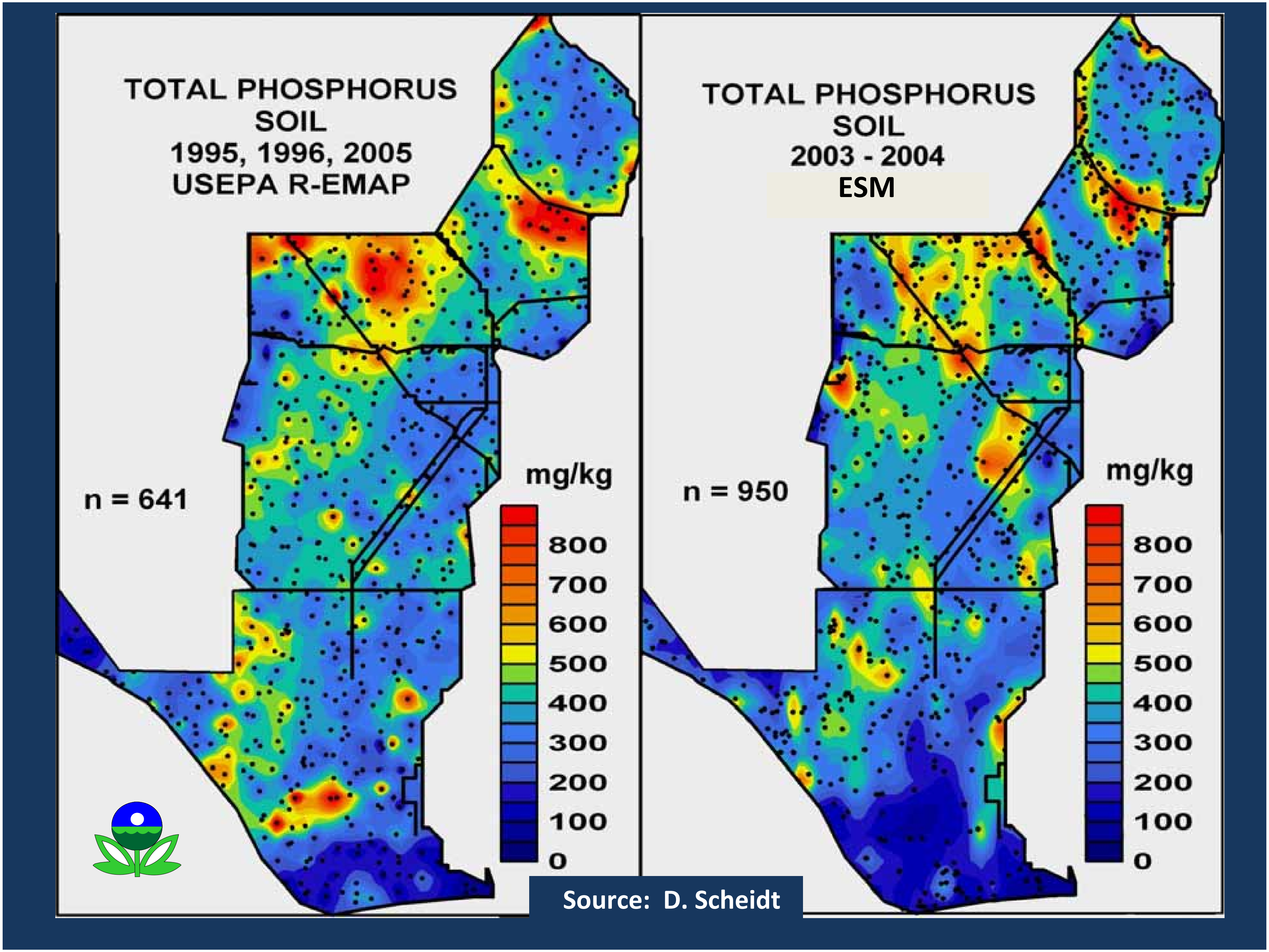
Reddy et al. 2005

Soil Thickness 1943 vs. 2005



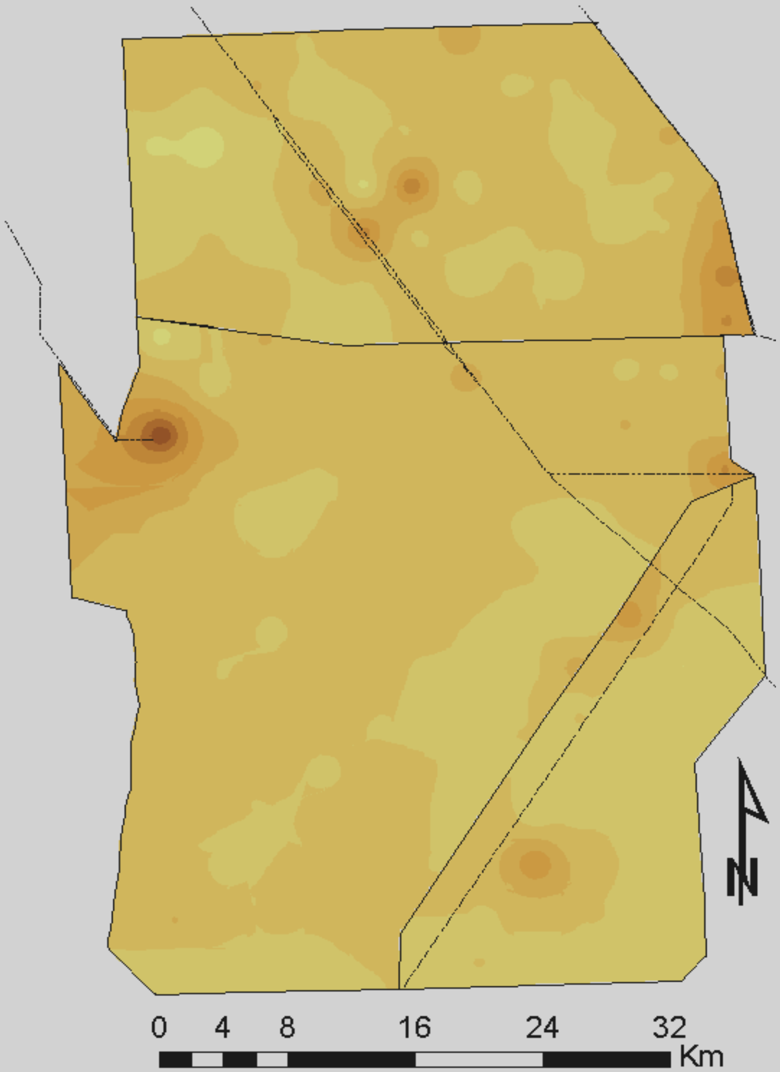


Scheidt & Kalla 2007

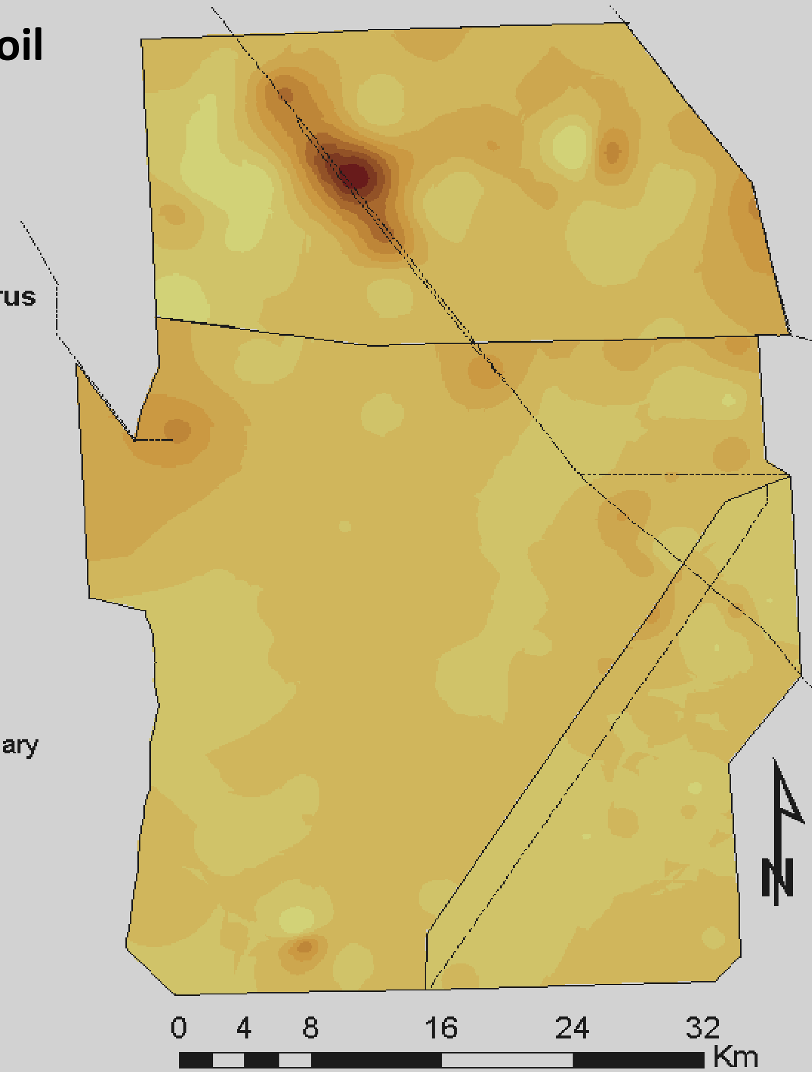

TOTAL PHOSPHORUS
SOIL
1995, 1996, 2005
USEPA R-EMAP
n = 641
mg/kg
800
700
600
500
400
300
200
100
0
TOTAL PHOSPHORUS
SOIL
2003 - 2004
ESM
n = 950
mg/kg
800
700
600
500
400
300
200
100
0
Source: D. Scheidt

ESM
0-10 cm Soil

WCA-3A 1992



WCA-3A 2003

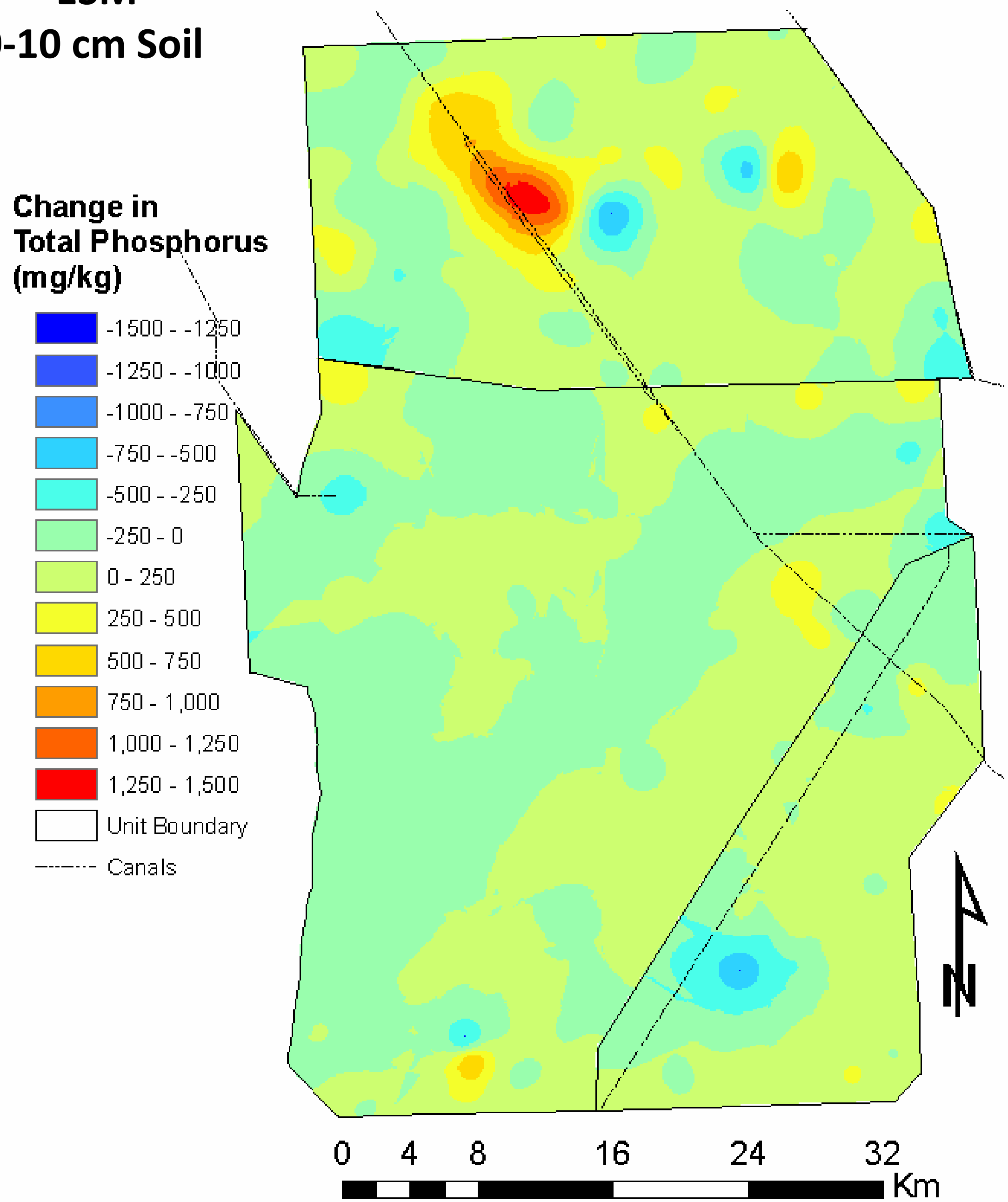


Total Phosphorus (mg/kg)

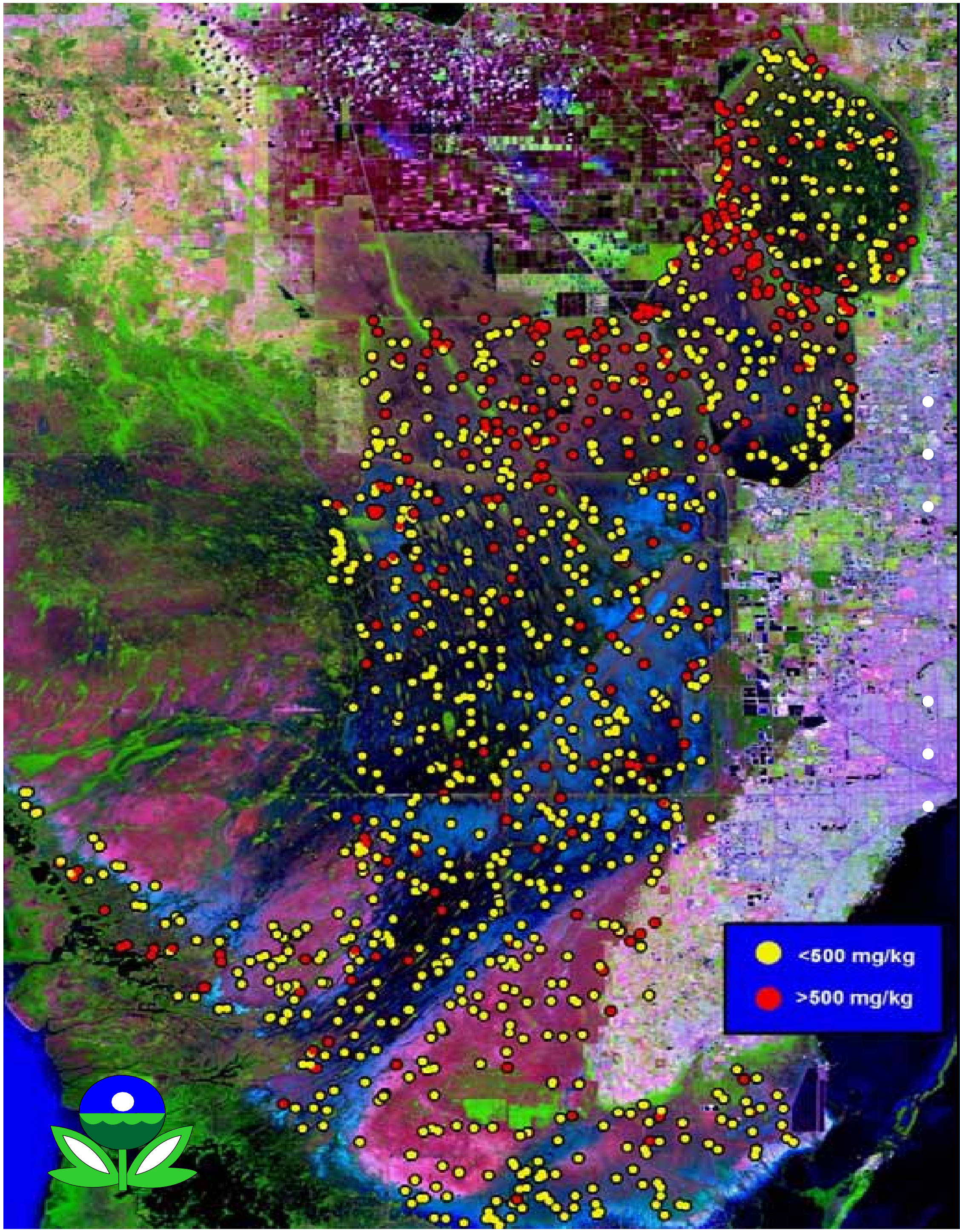
- < 200
- 200 - 400
- 400 - 600
- 600 - 800
- 800 - 1,000
- 1,000 - 1,200
- 1,200 - 1,400
- 1,400 - 1,600
- 1,600 - 1,800
- 1,800 - 2,000
- Unit Boundary
- Canals

Source: Bruland et al. 2007

ESM
0-10 cm Soil



Source: Bruland et al. 2007



R-EMAP & ESM Data

Total Phosphorus in Soil 2003-2005

R-EMAP

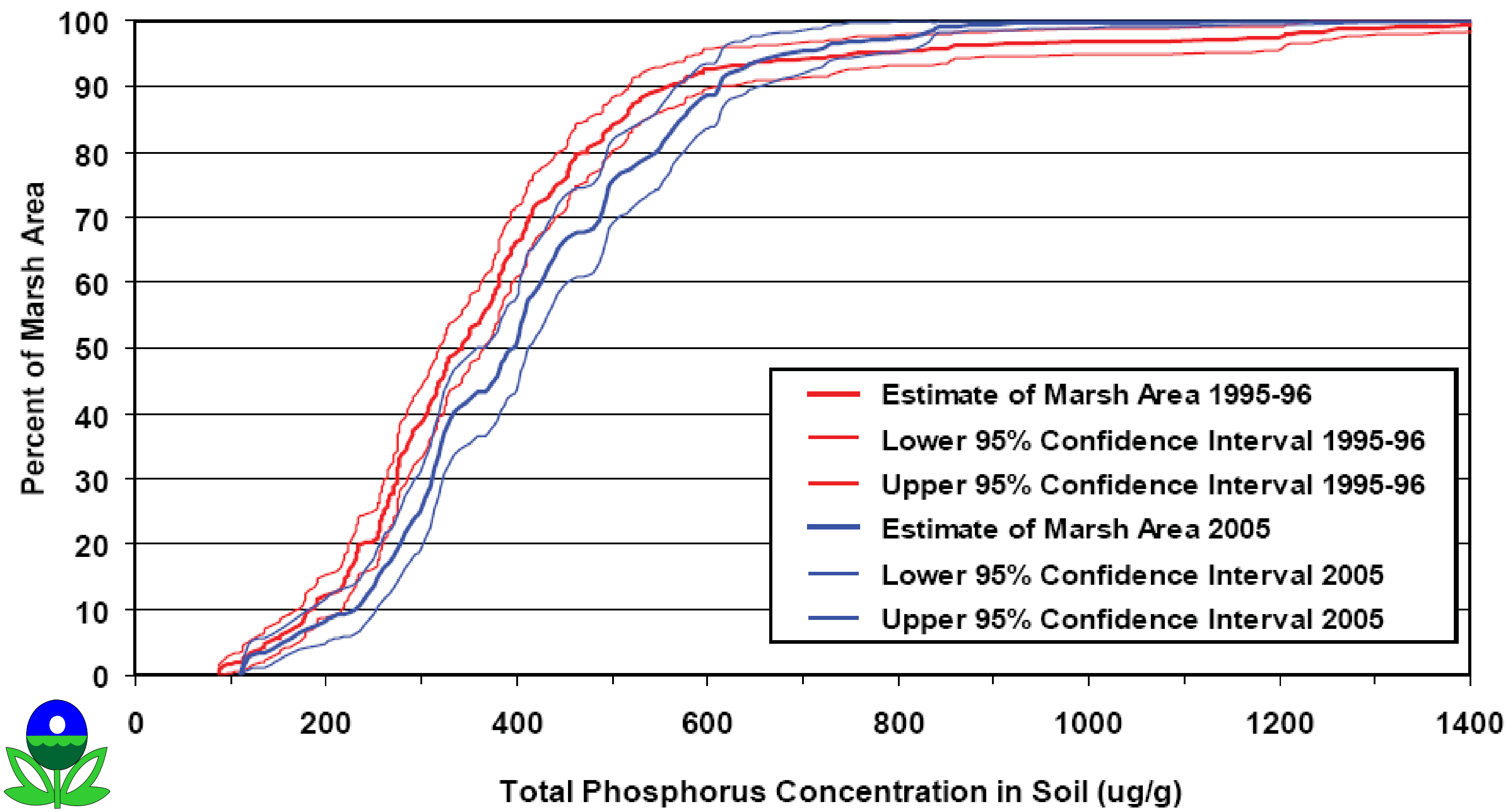
- 24 % > 500 mg/kg (impacted FDEP)
- 49 % > 400 mg/kg (CERP goal)
- Cattail present at 19 % of stations

ESM

- 21 % > 500 mg/kg (impacted FDEP)
- 42 % > 400 mg/kg (CERP goal)
- Cattail present at 22 % of stations

Scheidt & Kalla 2007

R-EMAP Probability Based Sampling Design



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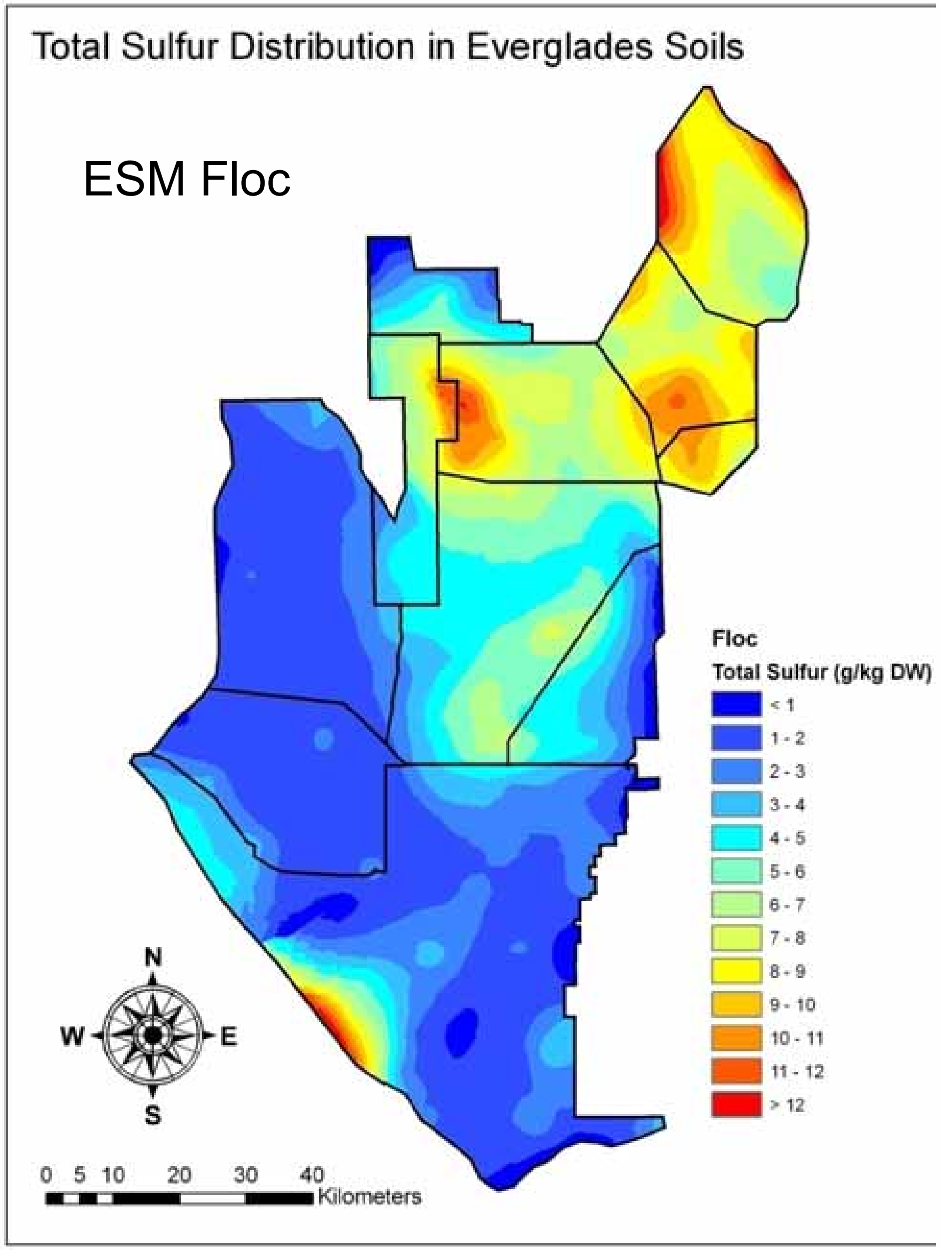
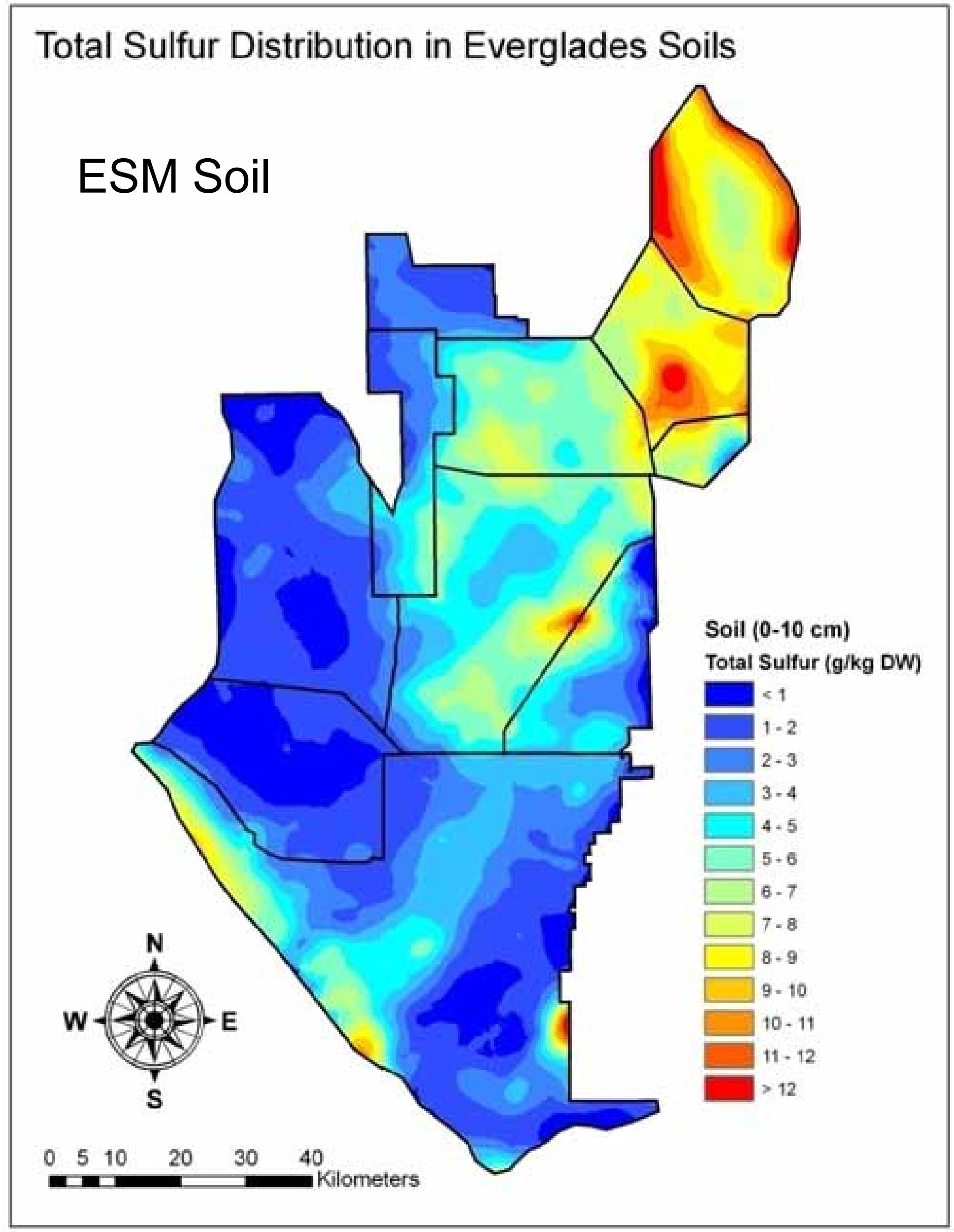
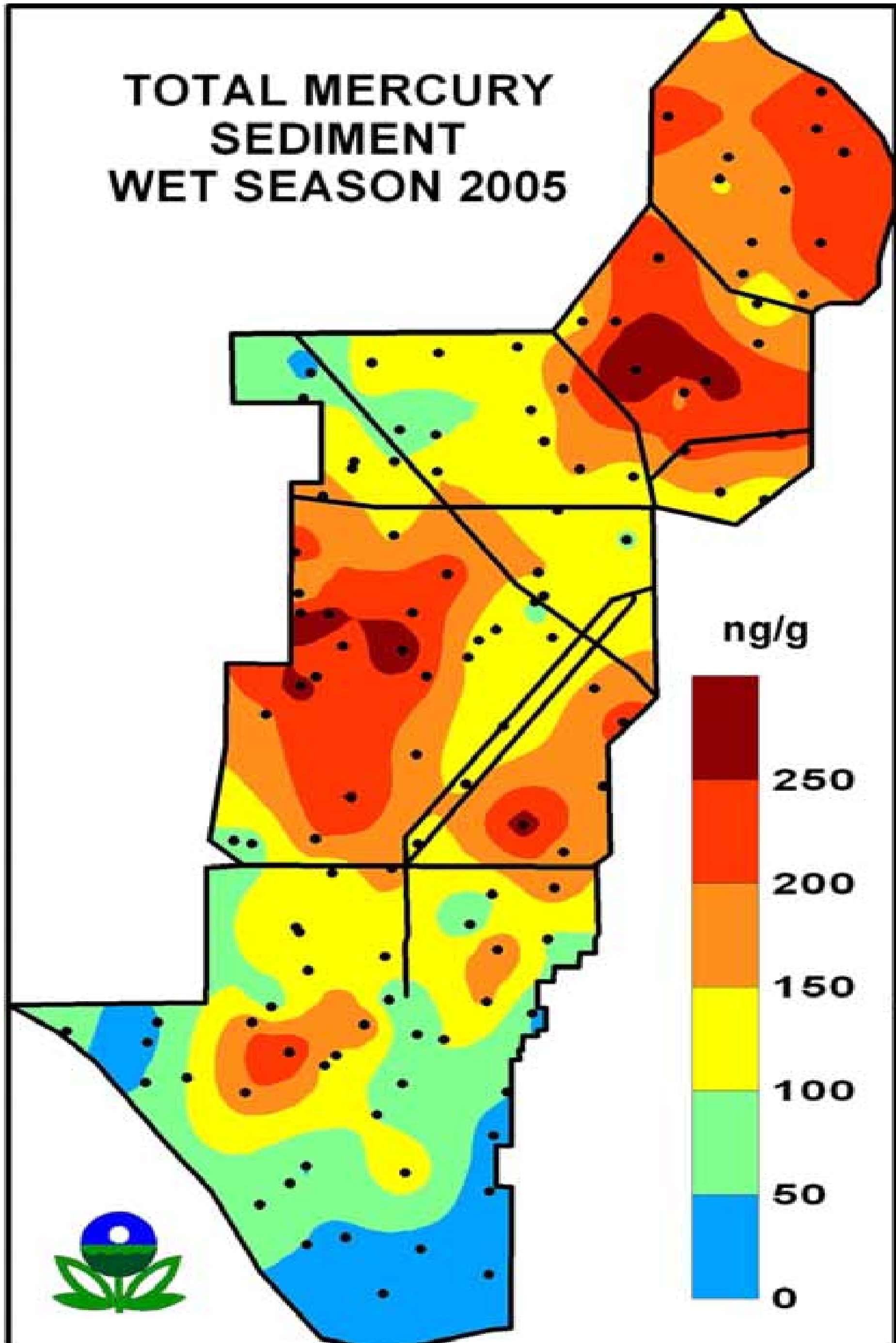




Source: Osborne et al. In preparation Maps by R. Ellis



General association with TS in WCA-1 and WCA-2A

THg adjacent to TS hotspots in WCA-3A

Potential "down stream" effect or is soil OM a factor in THg content

Scheidt & Kalla 2007

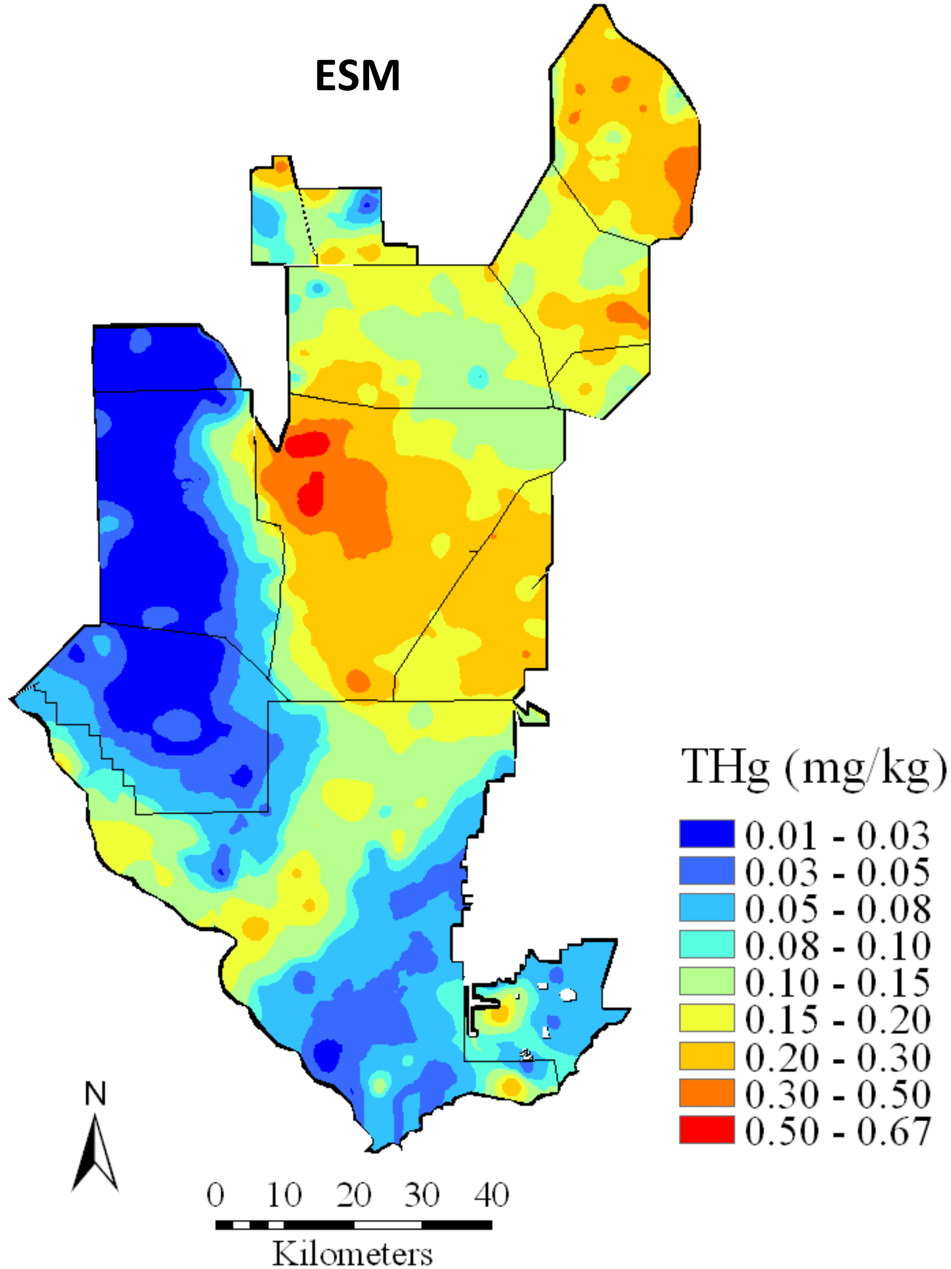
Similar THg patterns as R-EMAP

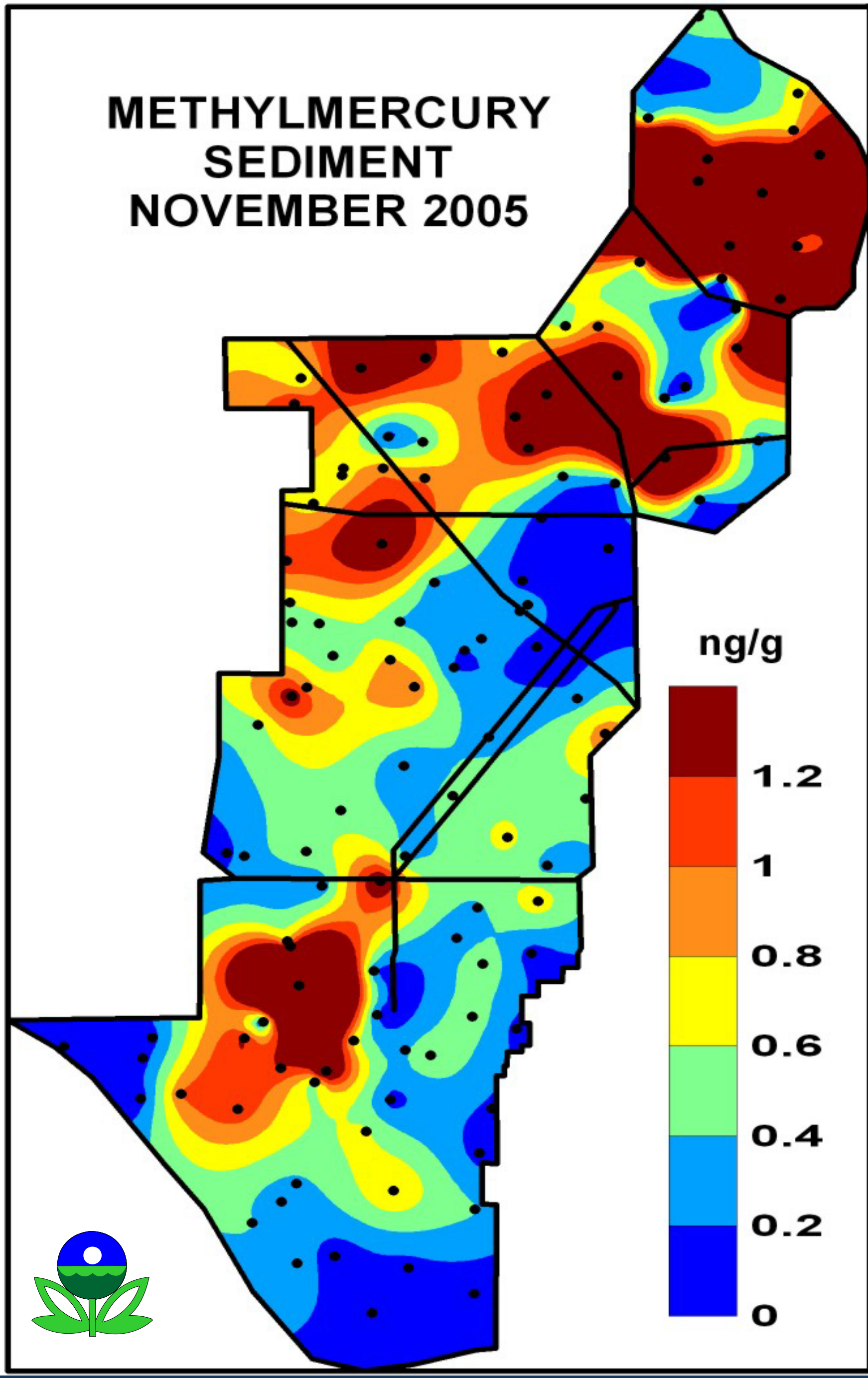
General association with TS in WCA-1 and 2A

THg adjacent (down stream) to TS hotspots in WCA-3A

Suggests aerial deposition vs. water conveyance

Source: Cohen *et al.*, in review





General association with THg but not with TS....?

Similar to areas of fish MeHg contamination

Scheidt & Kalla 2007

Conclusions

R-EMAP and ESM

Successful in the quantification and documentation of the spatial distribution of nutrients and contaminants in the Greater Everglades landscape

Identified landscape trends, landscape gradients, "hot spots", and areas of concern that will assist Researchers and Managers in directing future research and restoration efforts

Provided necessary baseline information for future assessment of restoration efforts

Challenges for Future Efforts

Cost and budget restraints…

Sampling design and numbers…

Short range variability…

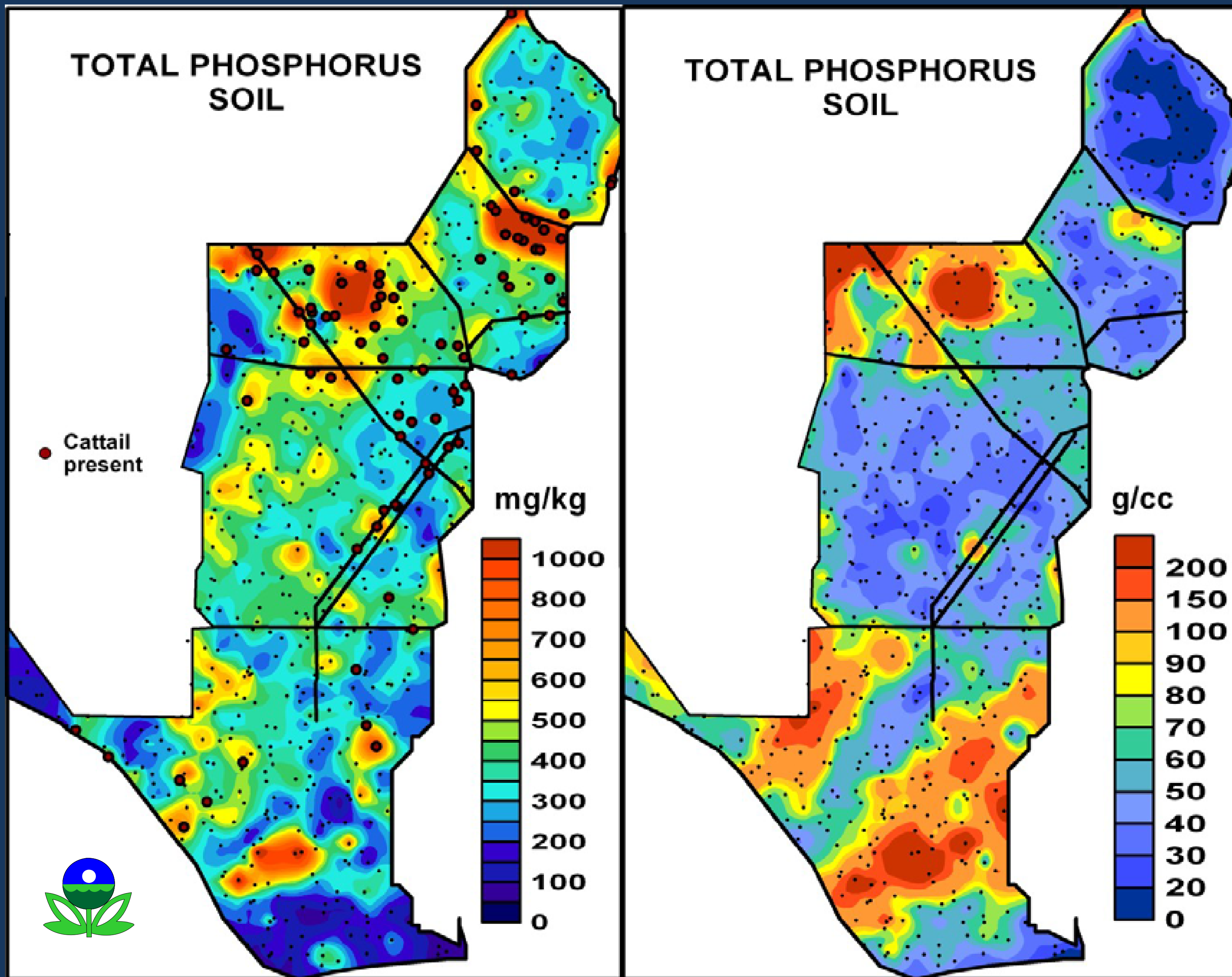
Lamsal et al. PS 1 #19

Time intervals…

Standardized method of floc determination…

Soil sampling depth 5, 10, 20 cm…


Thank You
Questions?



(Scheidt & Kalla 2007)