Drivers of Geospatial and Temporal Variability in the Distribution of Mercury and Methylmercury in Everglades National Park

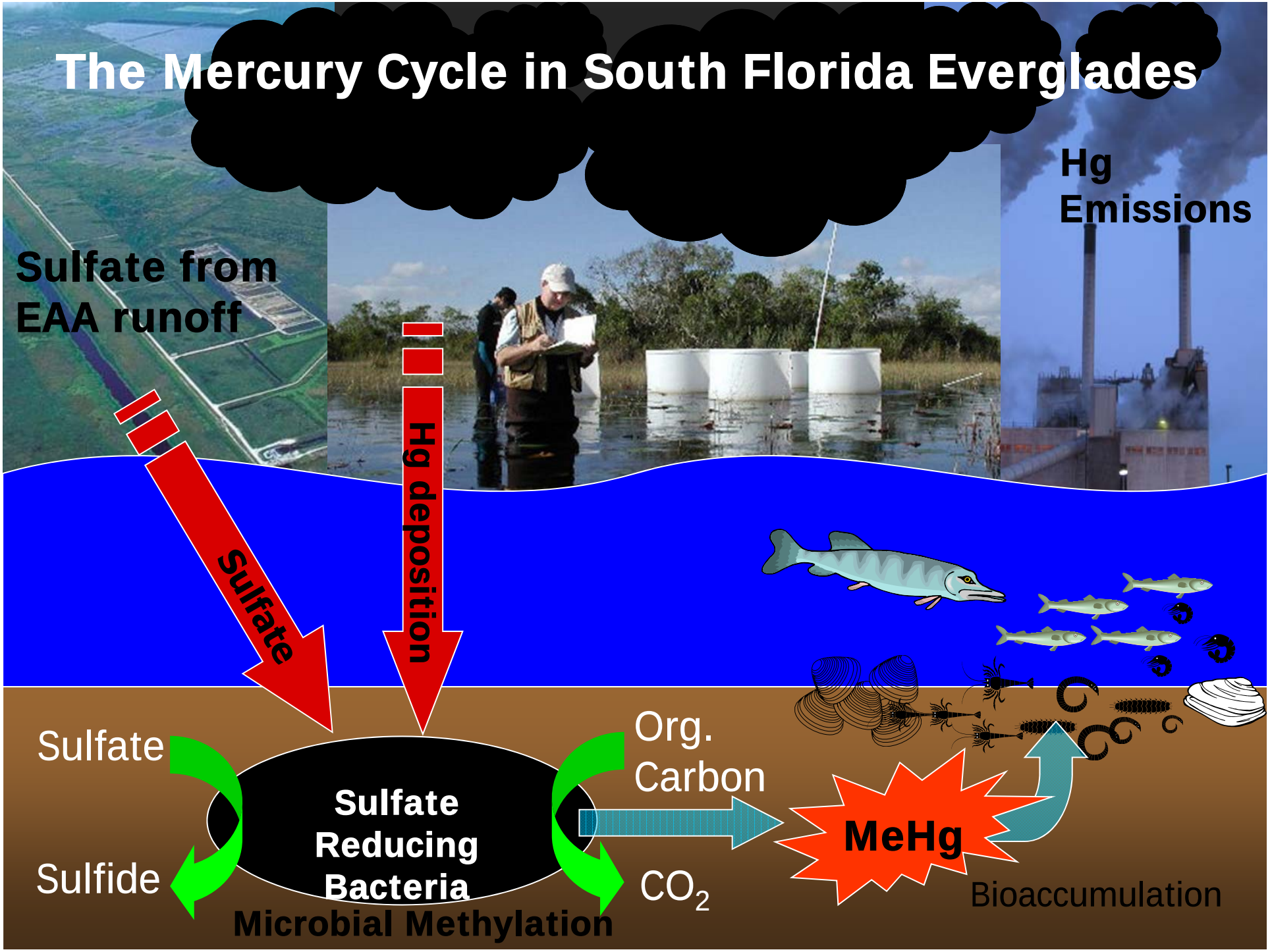


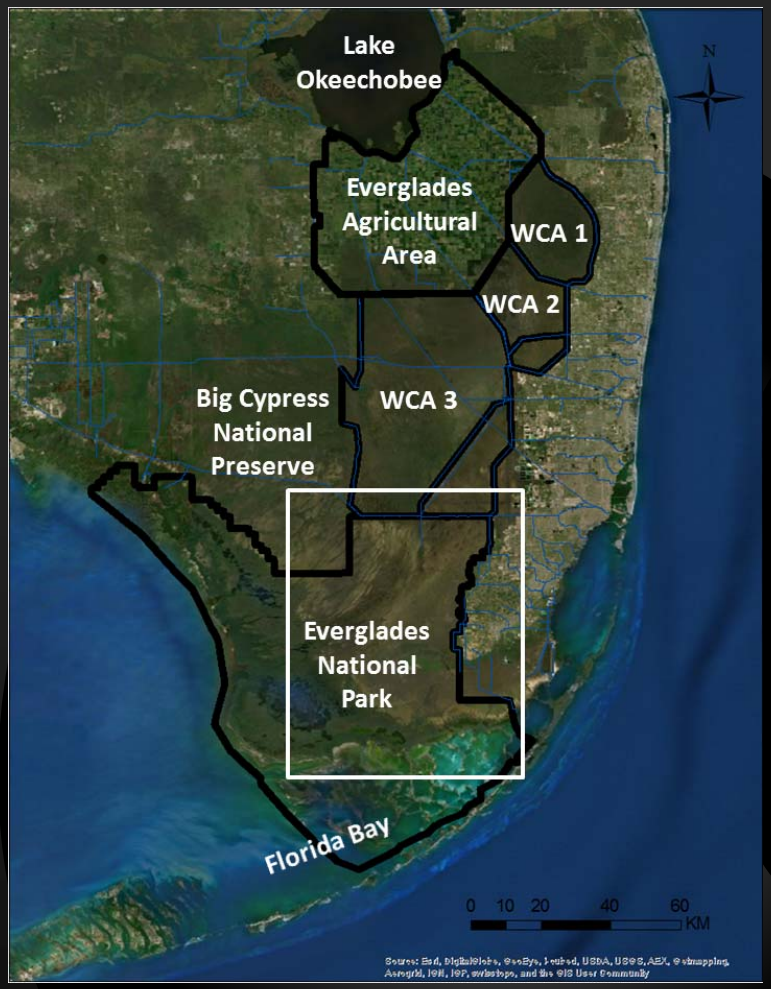
Morgan Maglio[1], David Krabbenhoft[1], Michael Tate[1], John DeWild[1], Jacob Ogorek[1], Charlie Thompson[1], George Aiken[1], William Orem[1], Jeffrey Kline[2], Joffre Castro[2], Cynthia Gilmour[3]

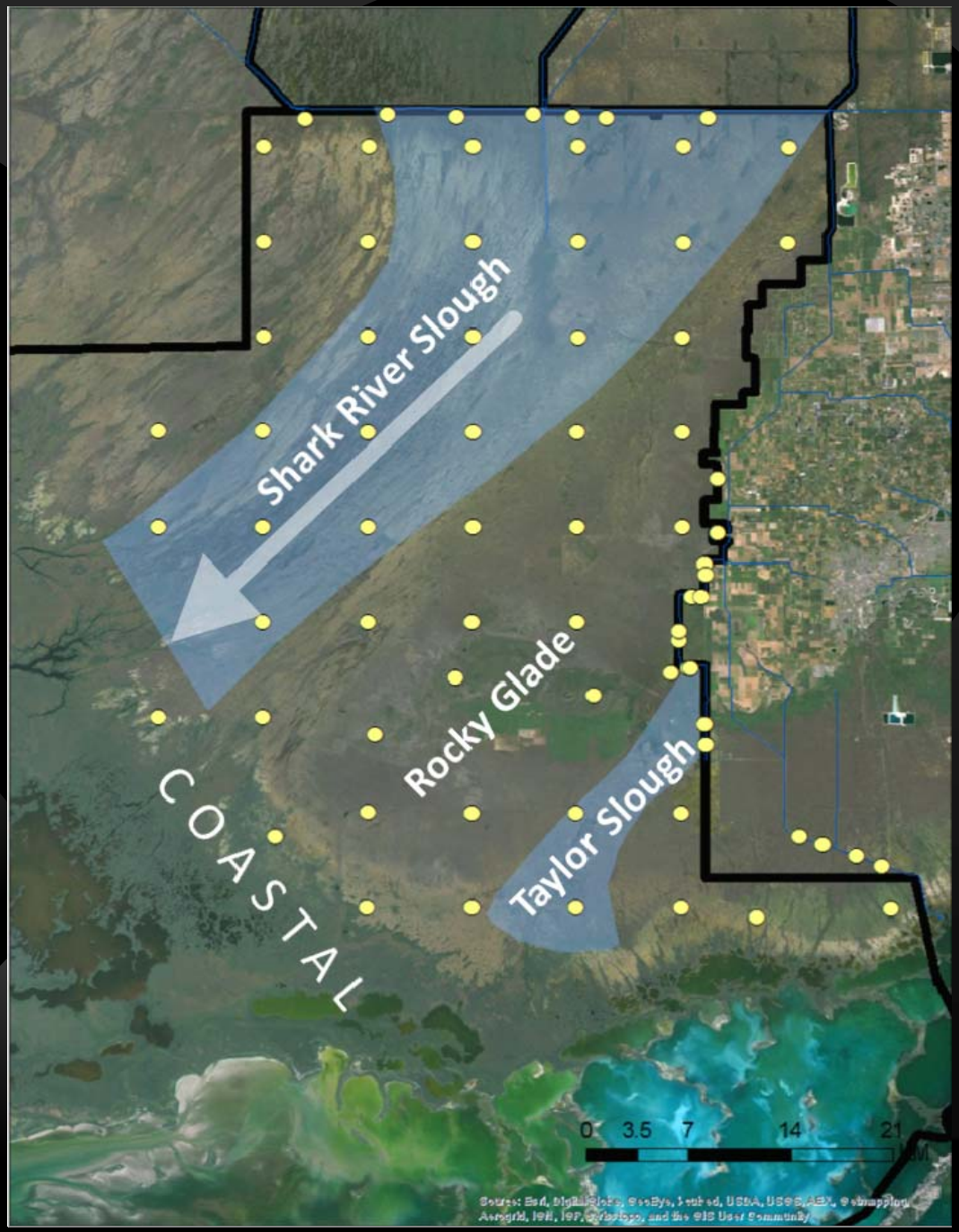
[1] U. S. Geological Survey,
[2] National Park Service, Everglades National Park, Homestead, FL, USA
[3] Smithsonian Estuarine Reseach Center, Edgewater, MD, USA

USGS

Funding & Support: USGS-PES and NPS


The Mercury Cycle in South Florida Everglades
Sulfate from EAA runoff
Hg Emissions
Sulfate
Hg deposition
Sulfate
Sulfide
Sulfate Reducing Bacteria
Microbial Methylation
Org. Carbon
CO_2
MeHg
Bioaccumulation



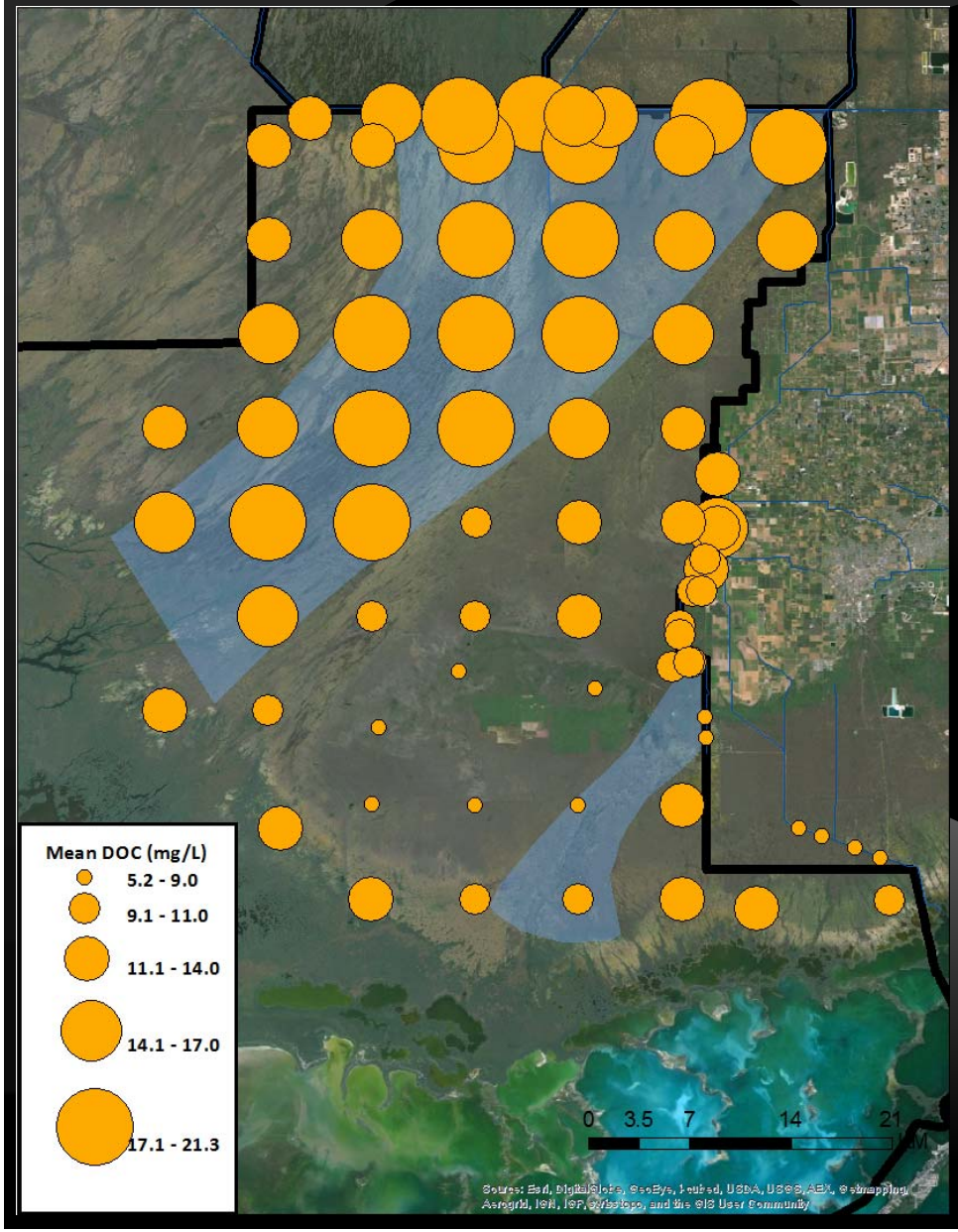


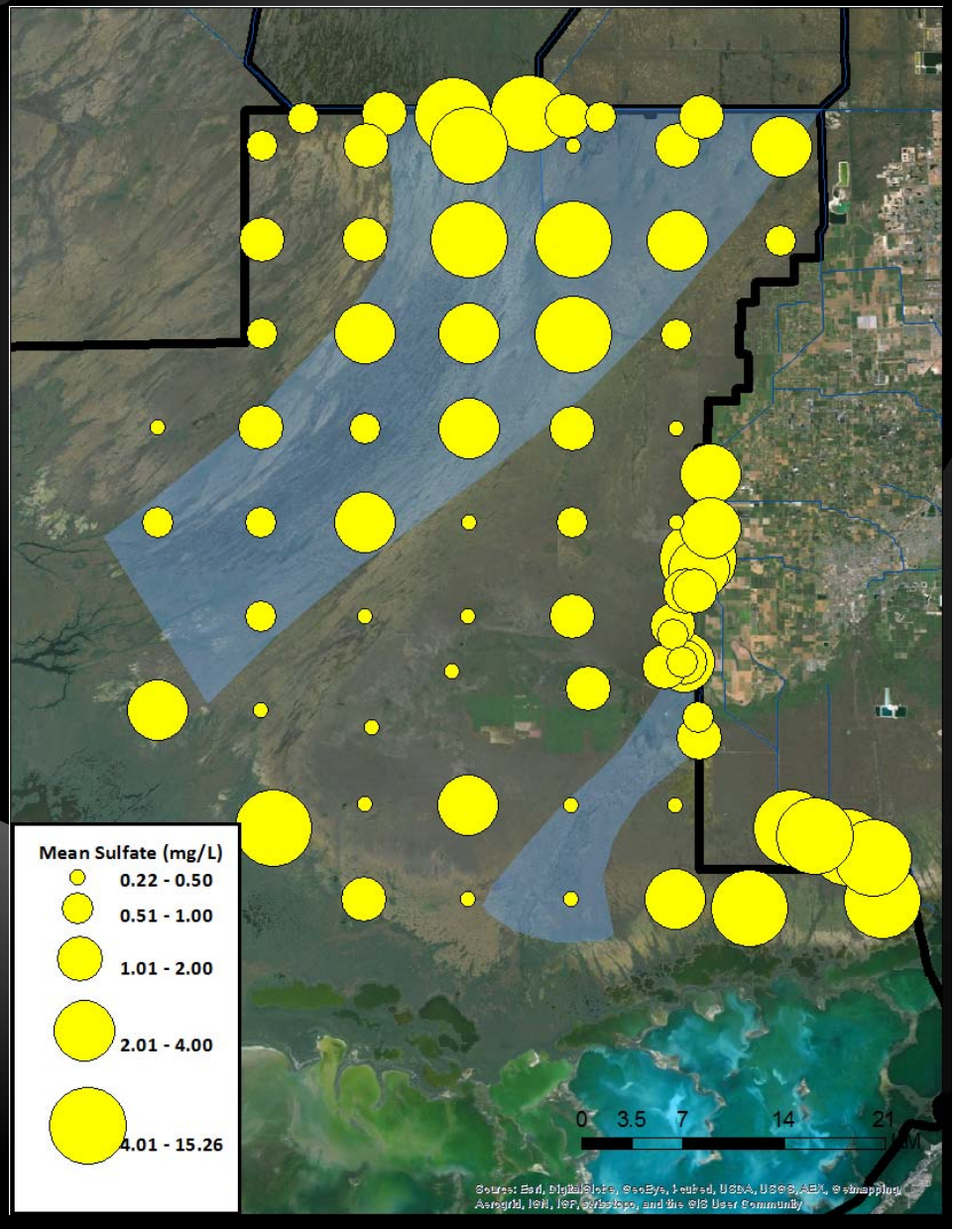
Sampling network:

- 76 sites covering marsh and canals
- Sampled annually in Oct. 2008 - 2013
- Surface water and Mosquitofish (Gambusia)
- Analyzed for Hg, MeHg, DOC, SUVA, sulfate, & other anions

Average DOC and Sulfate Distributions (6-year means)

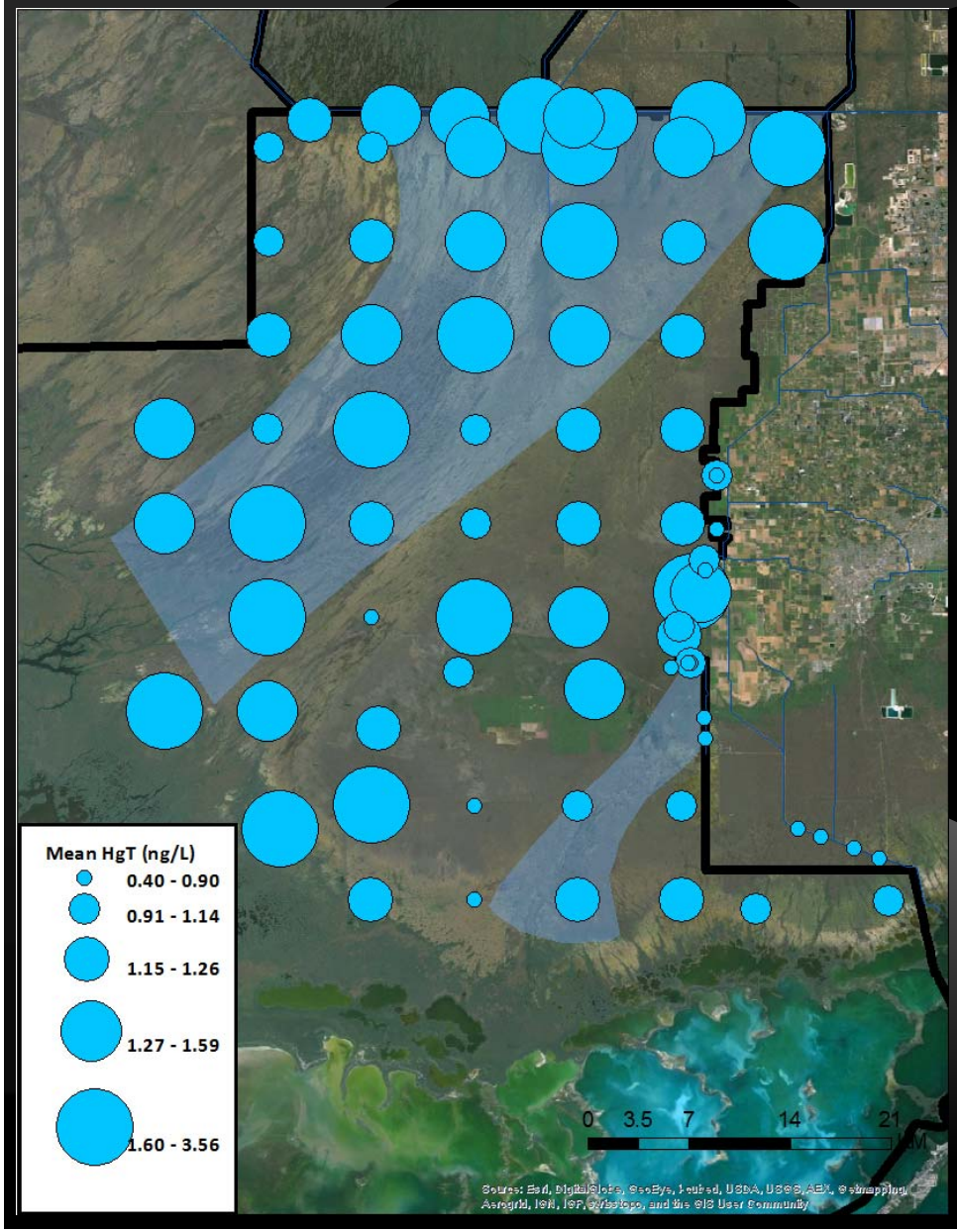
Distinct patterns indicate canal water influence

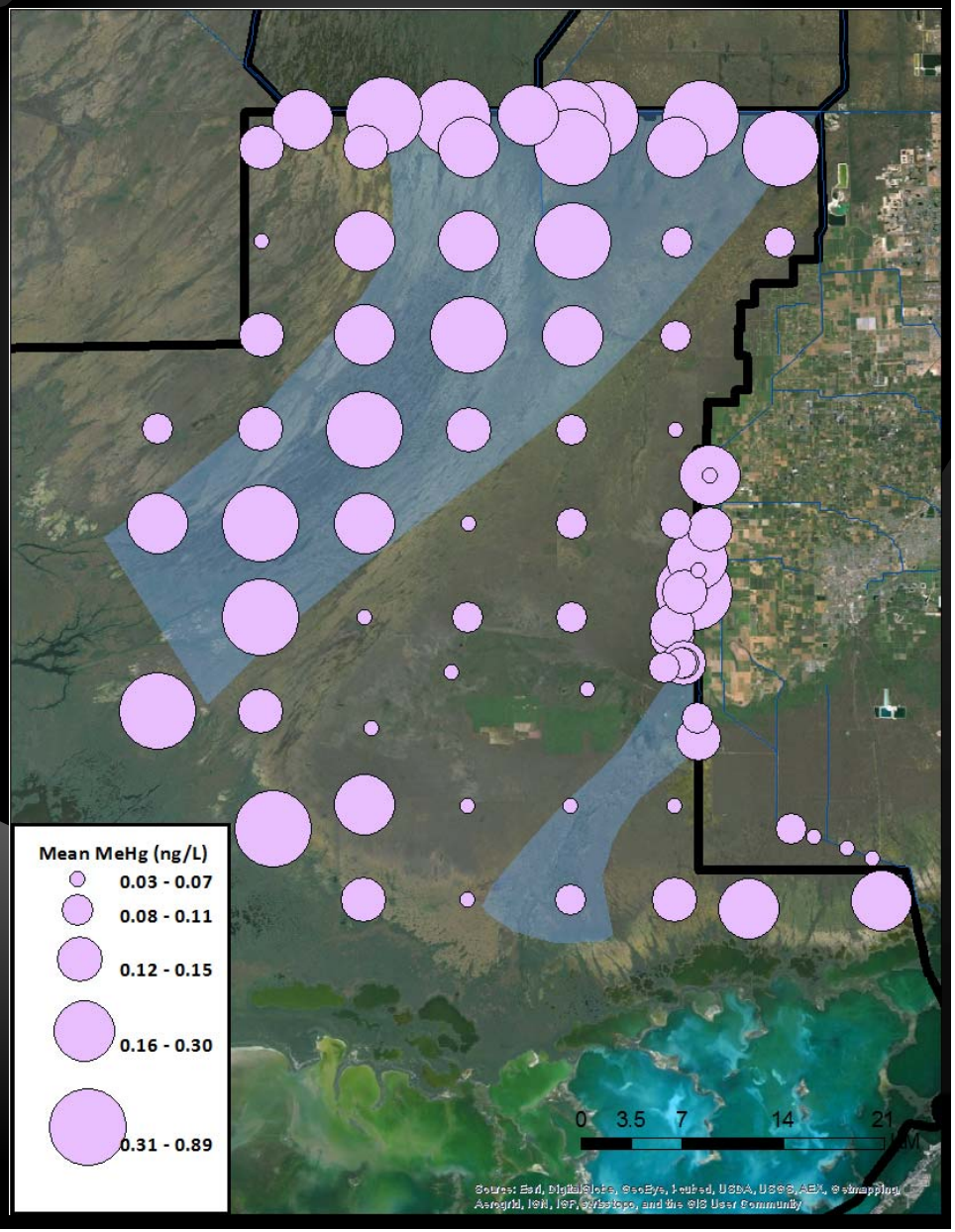




Average HgT and MeHg Distributions (6-year means)

Methylation occurs in locations with sufficient DOC, Sulfate, & HgT

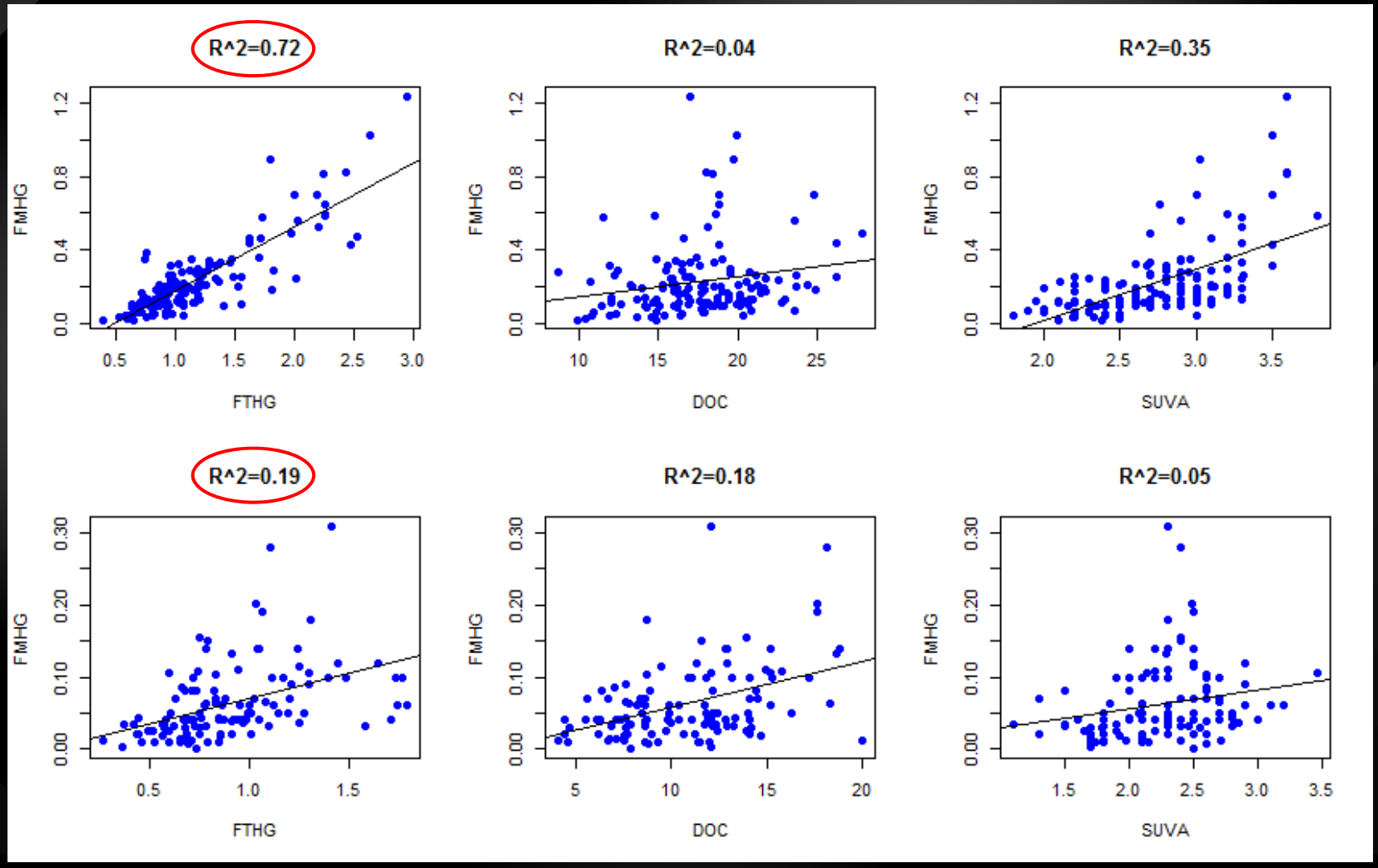




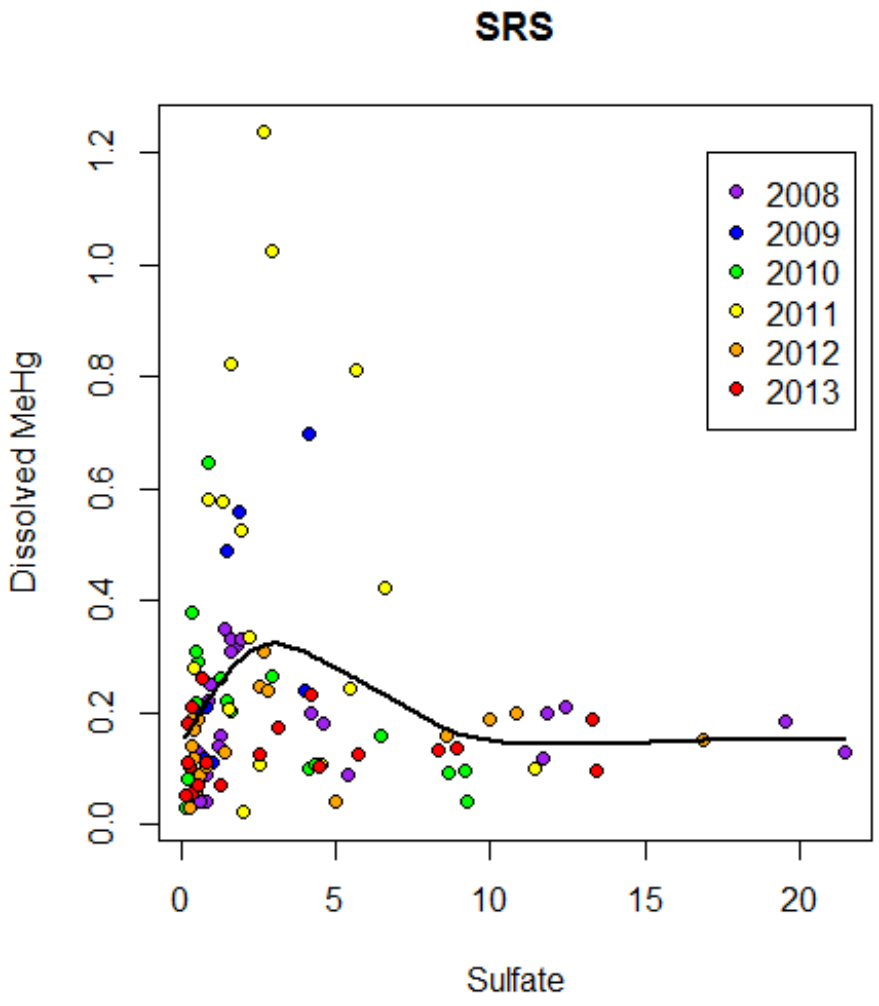
HgT is a stronger predictor of MeHg concentrations for SRS sites than marsh sites

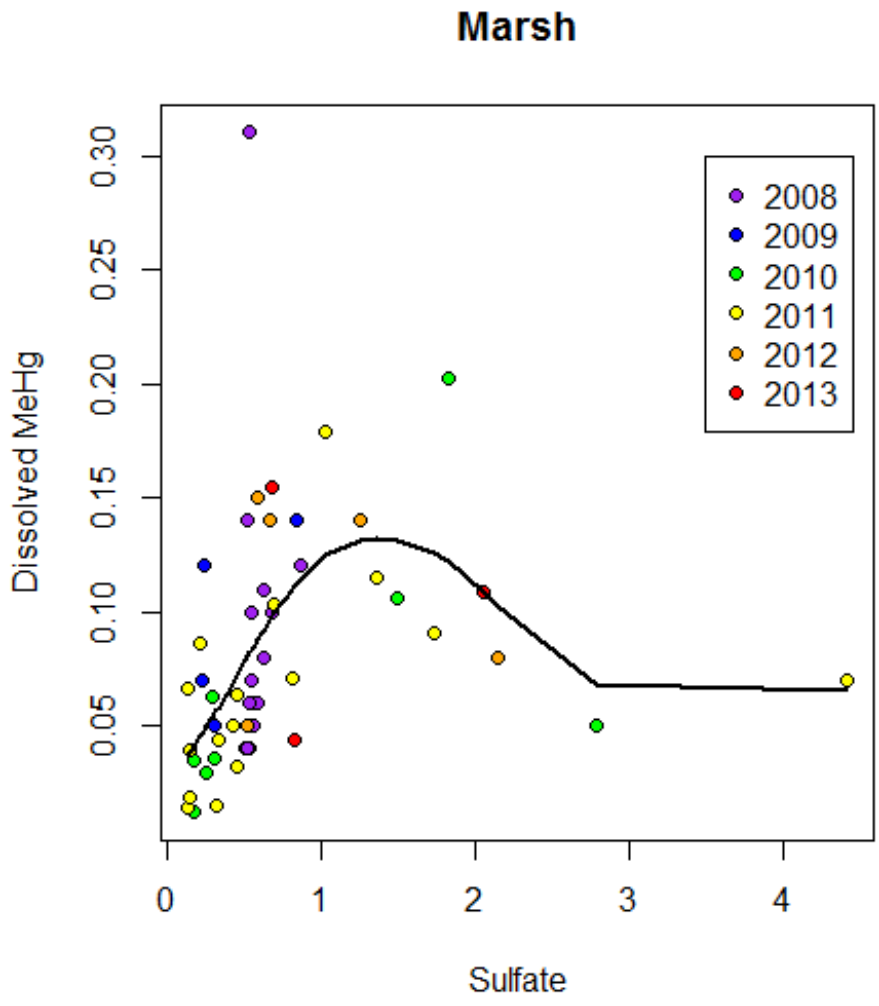
SRS

Marsh



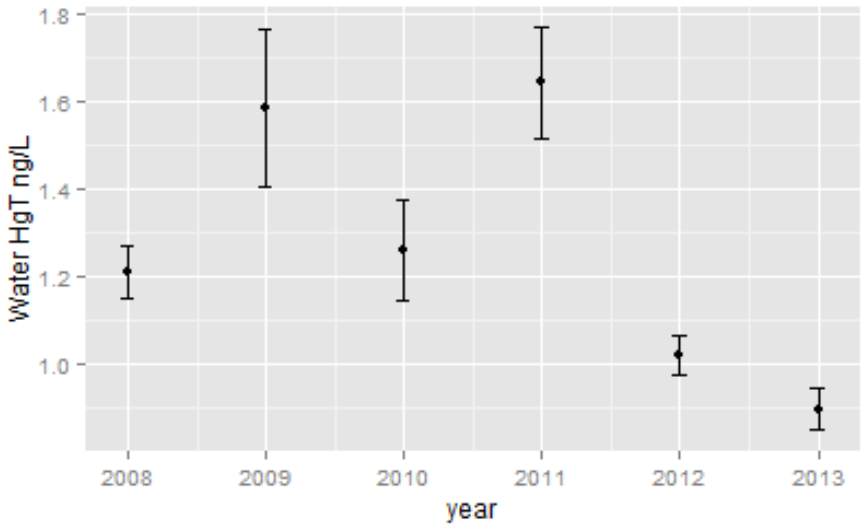
Nonlinear relationship between sulfate and MeHg in ENP

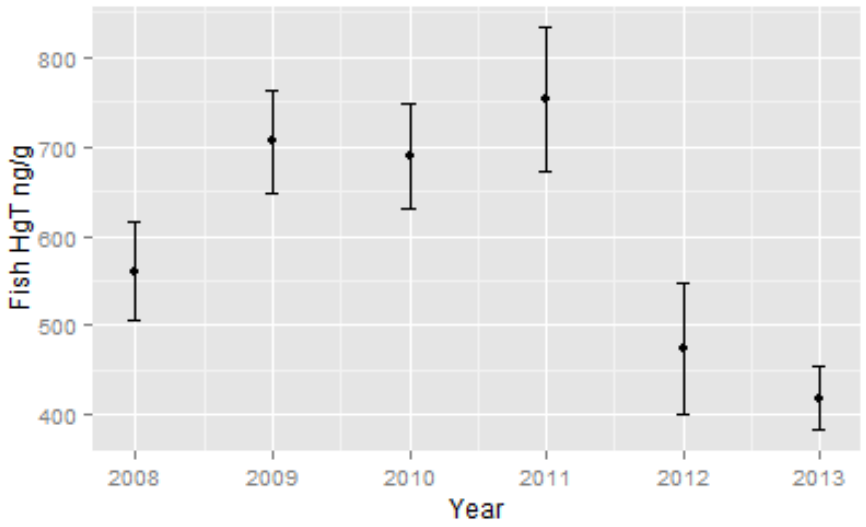


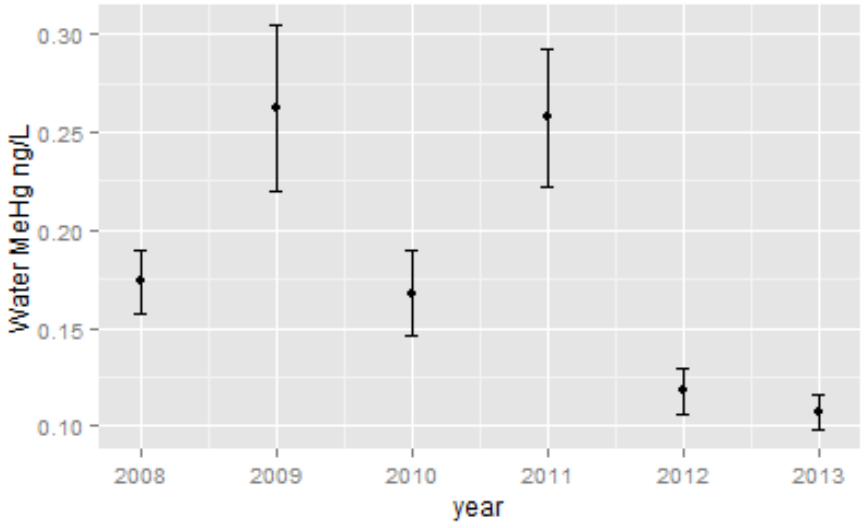


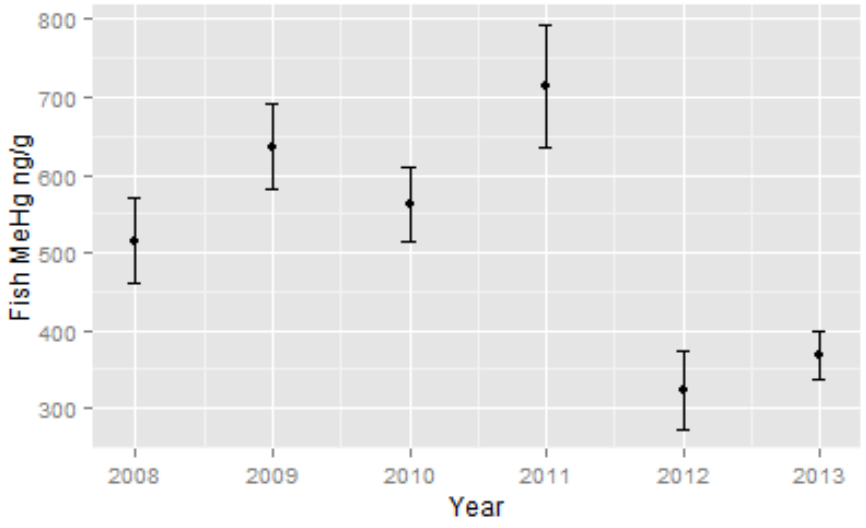
Smooth spline fit with 5 degrees of freedom

Surface Water and Mosquitofish HgT and MeHg follow similar general interannual trends

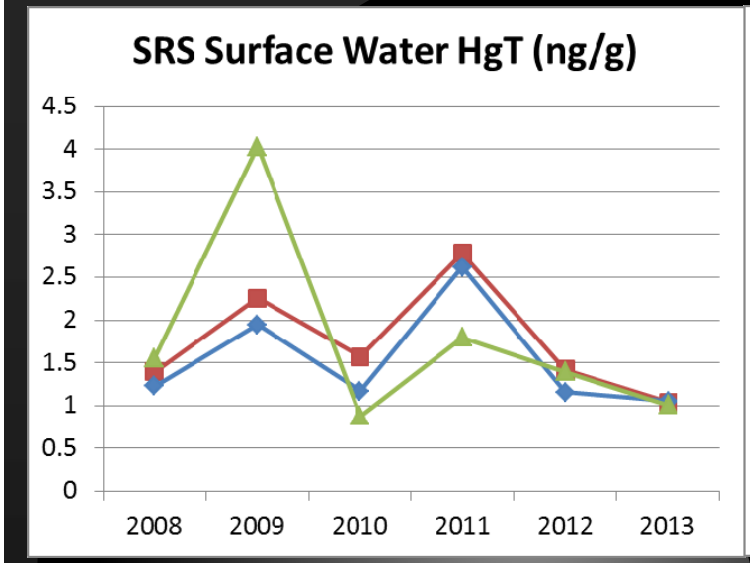


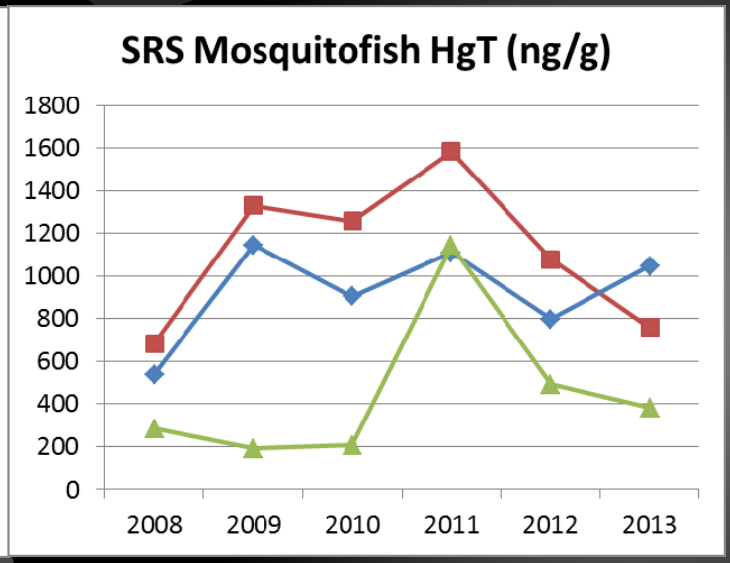


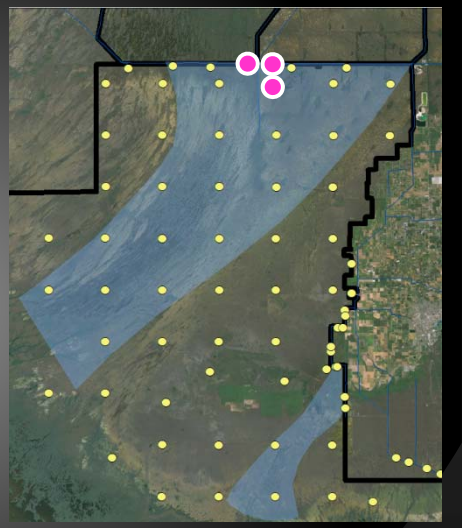


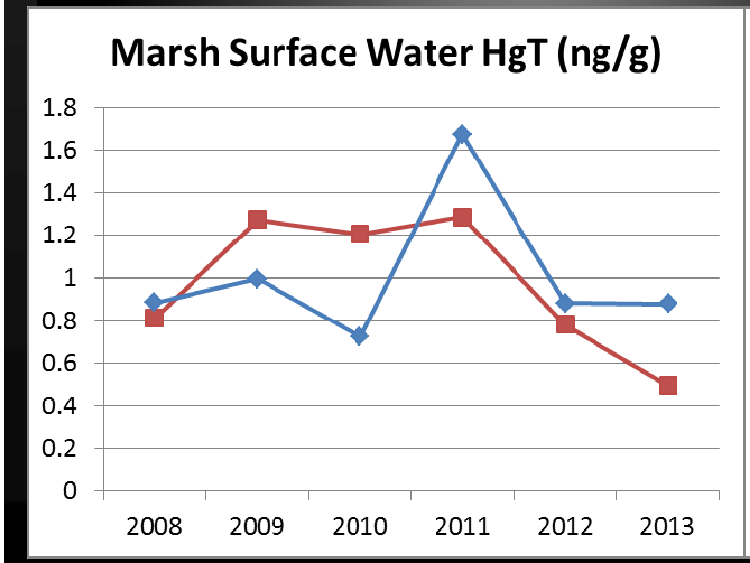


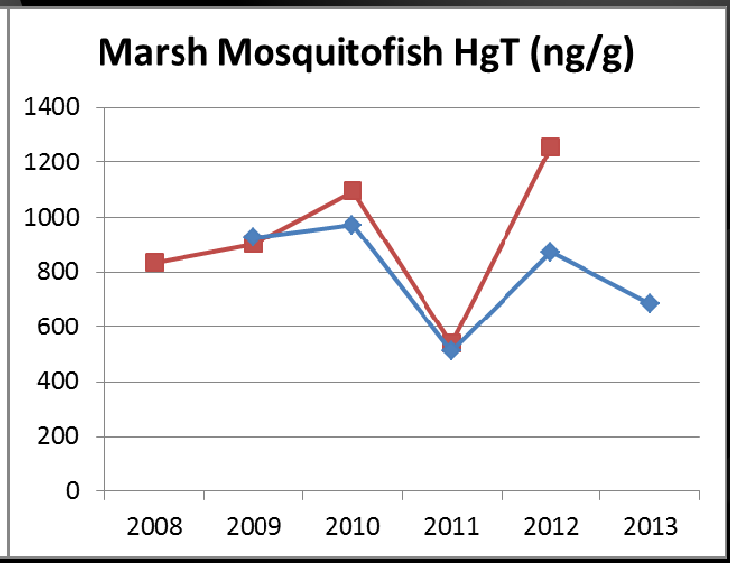
Regional interannual variability of Hg in Mosquitofish can differ from surface water

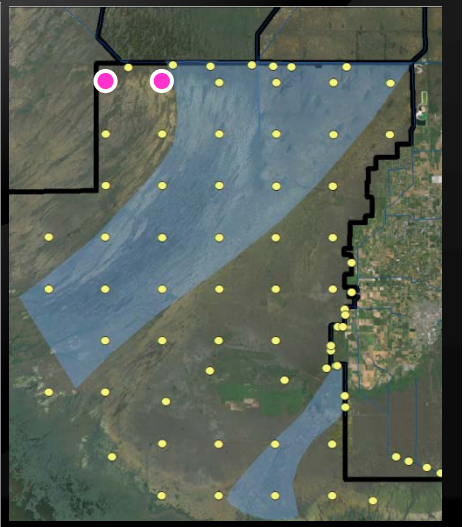




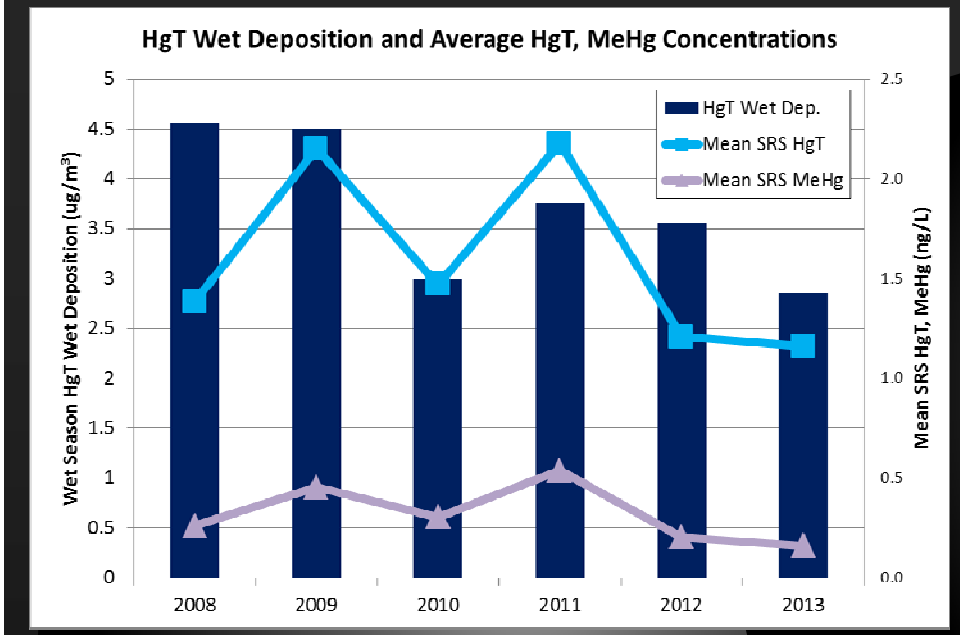


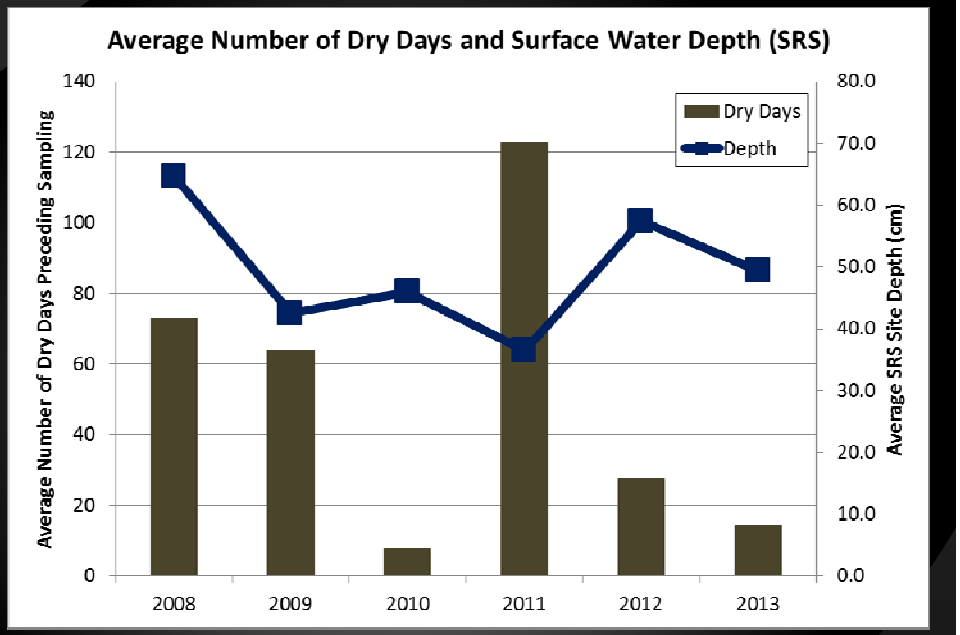


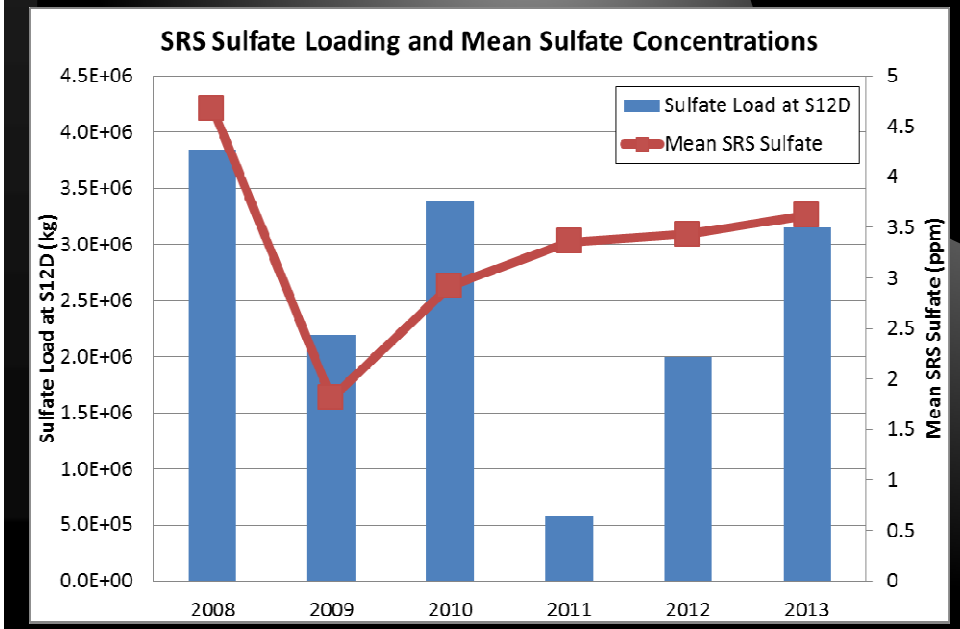


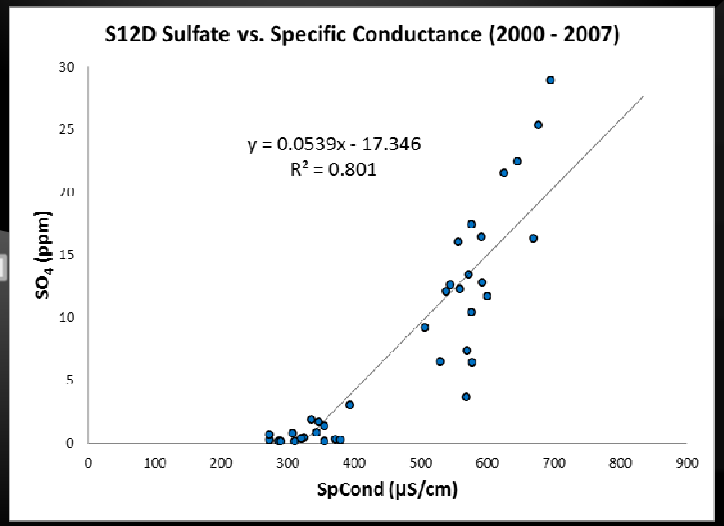


Drivers of Everglades MeHg Variability (in SRS)



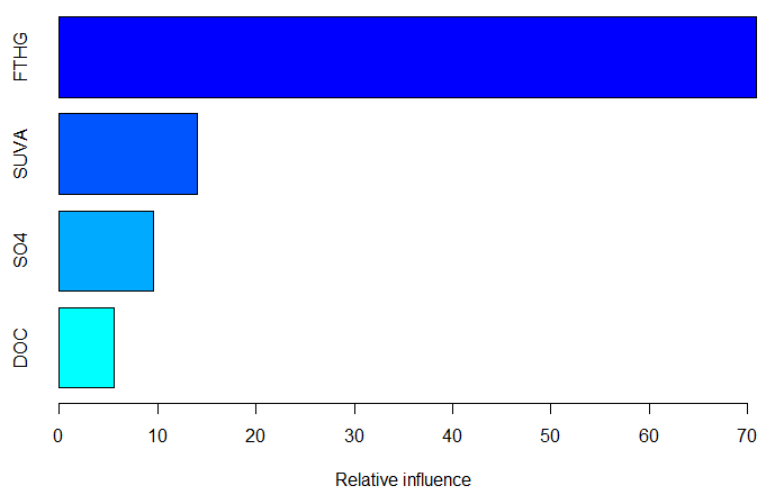


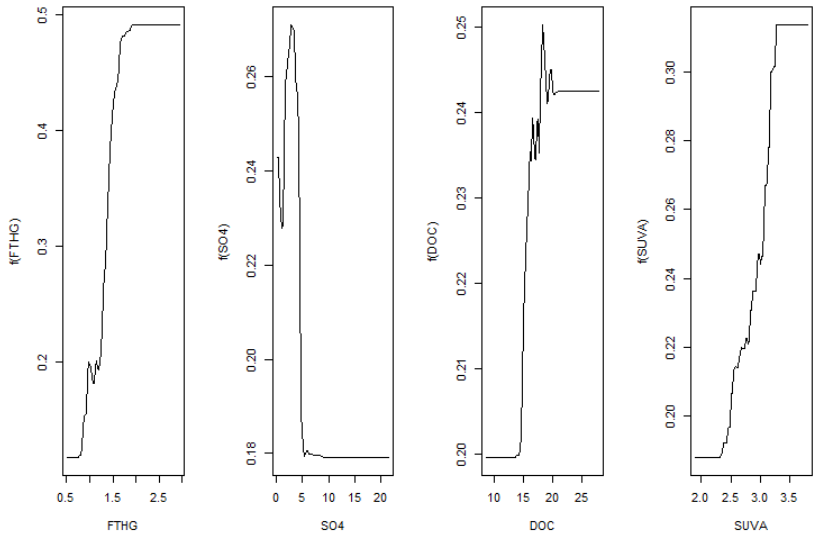




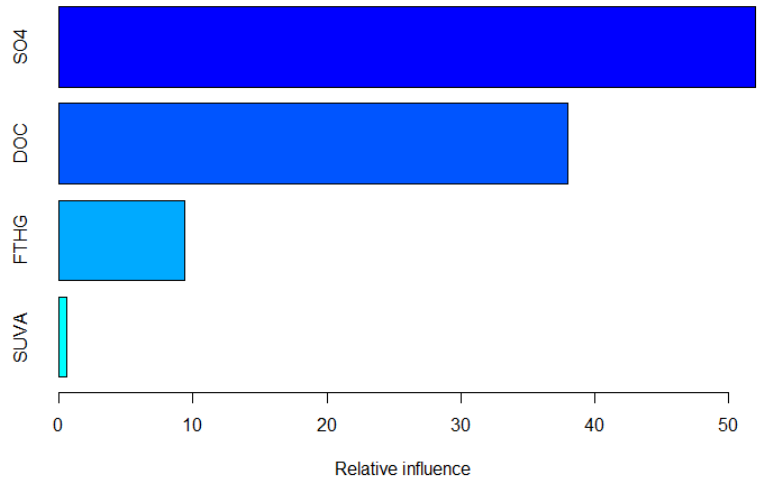
The relative importance of predictors of MeHg differs from SRS to marsh

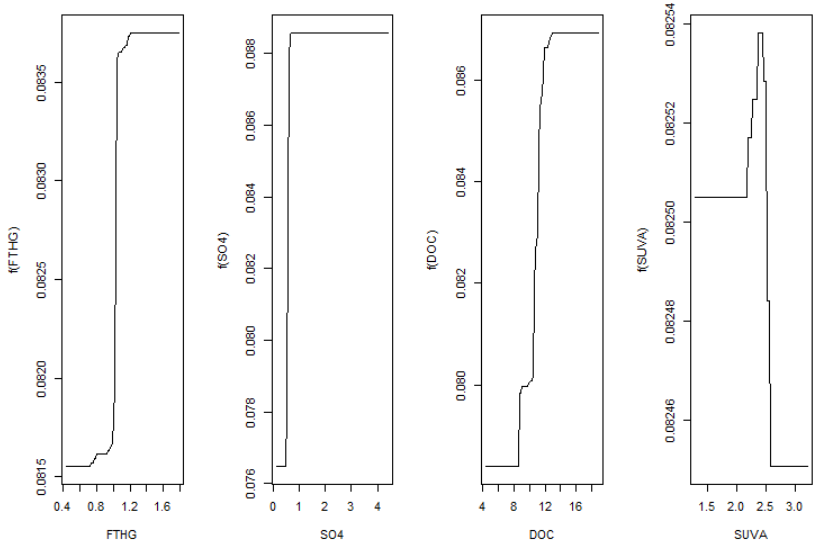
SRS





Marsh





Gradient boosted regression – tuning parameters optimized using 10-fold cross validation

Discussion: drivers of MeHg production and variability in Everglades National Park

- ENP has substantial spatial and temporal variability in MeHg levels. SRS generally has higher levels than areas not affected by canal water.
- HgT is a very strong predictor of MeHg in SRS. This relationship weakens in the rest of the marsh.
- Delivery of sulfate and DOC by canal water plays a key role in MeHg production in ENP.
- Sulfate loads to ENP (particularly SRS) drive MeHg variability but rehydration of legacy sulfate after extremely dry years may serve as a major source of sulfate to the system.
- The relative importance of variables other than HgT (Sulfate, DOC) is greater in the marsh than in SRS. Conditions for methylation are less limited in SRS due to the presence of canal water.

USGS