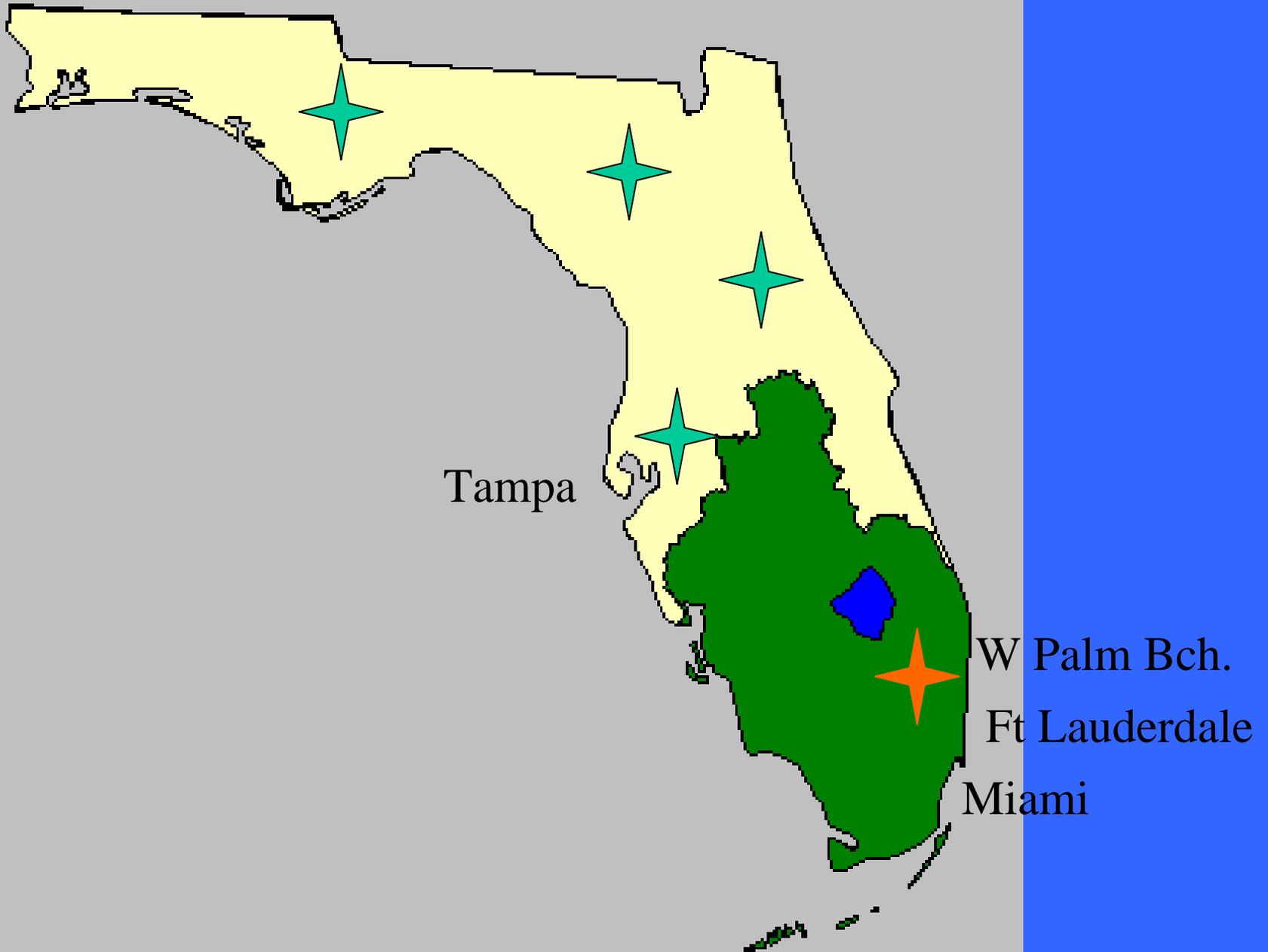


The Florida Mercury Science Program

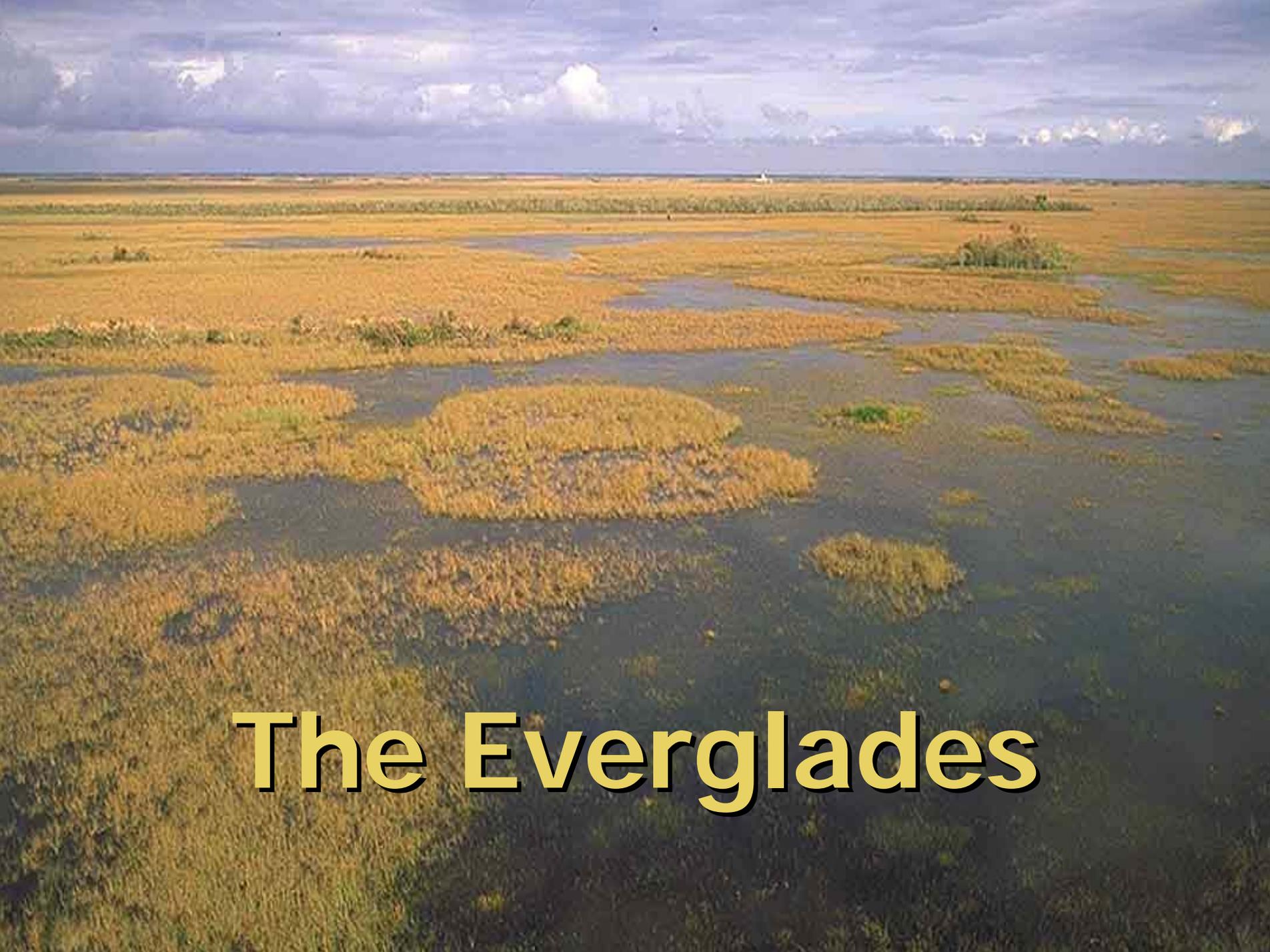


Tom Atkeson, Coordinator
Mercury & Applied Science



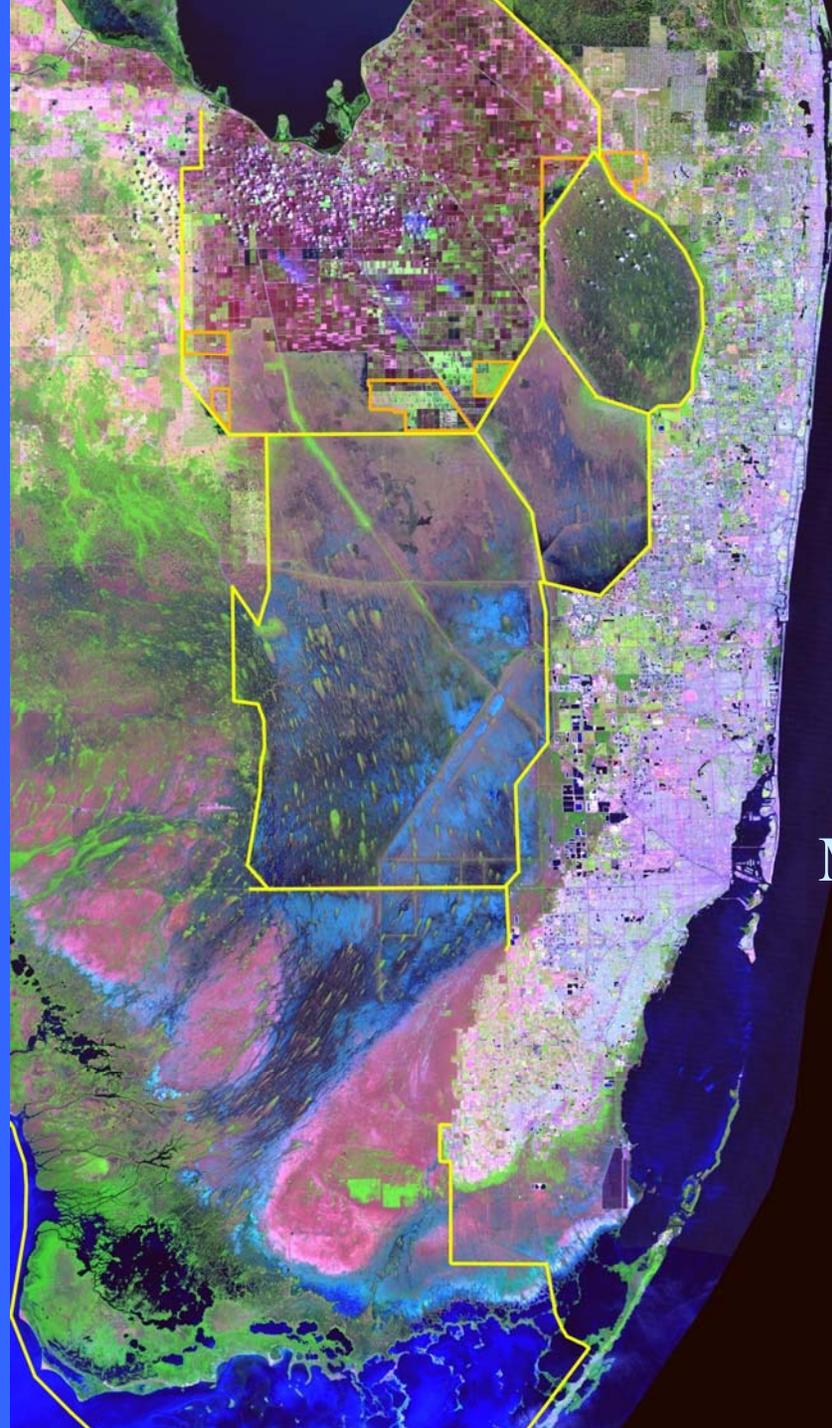
Tampa

W Palm Bch.
Ft Lauderdale
Miami



The Everglades

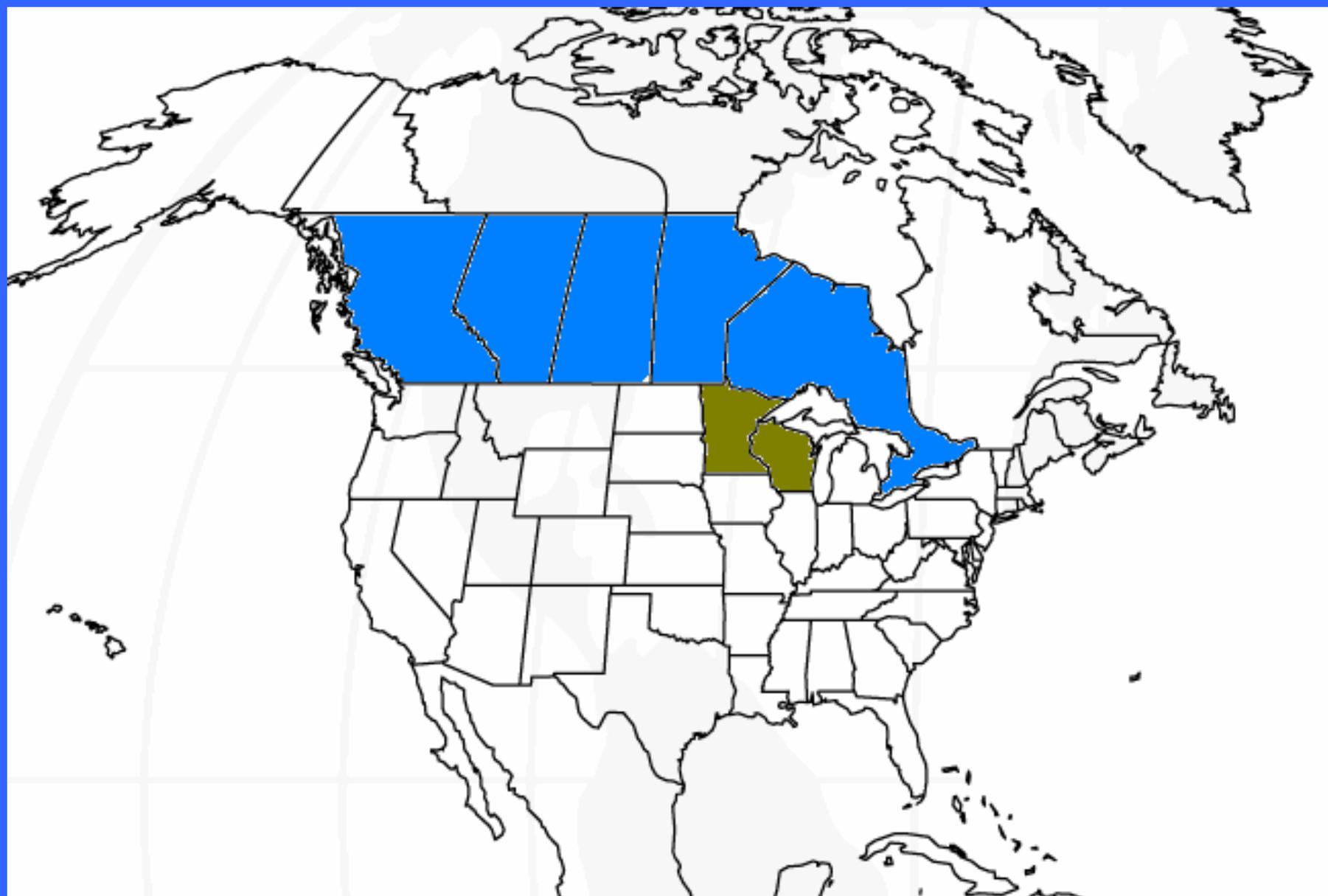
L. Okeechobee

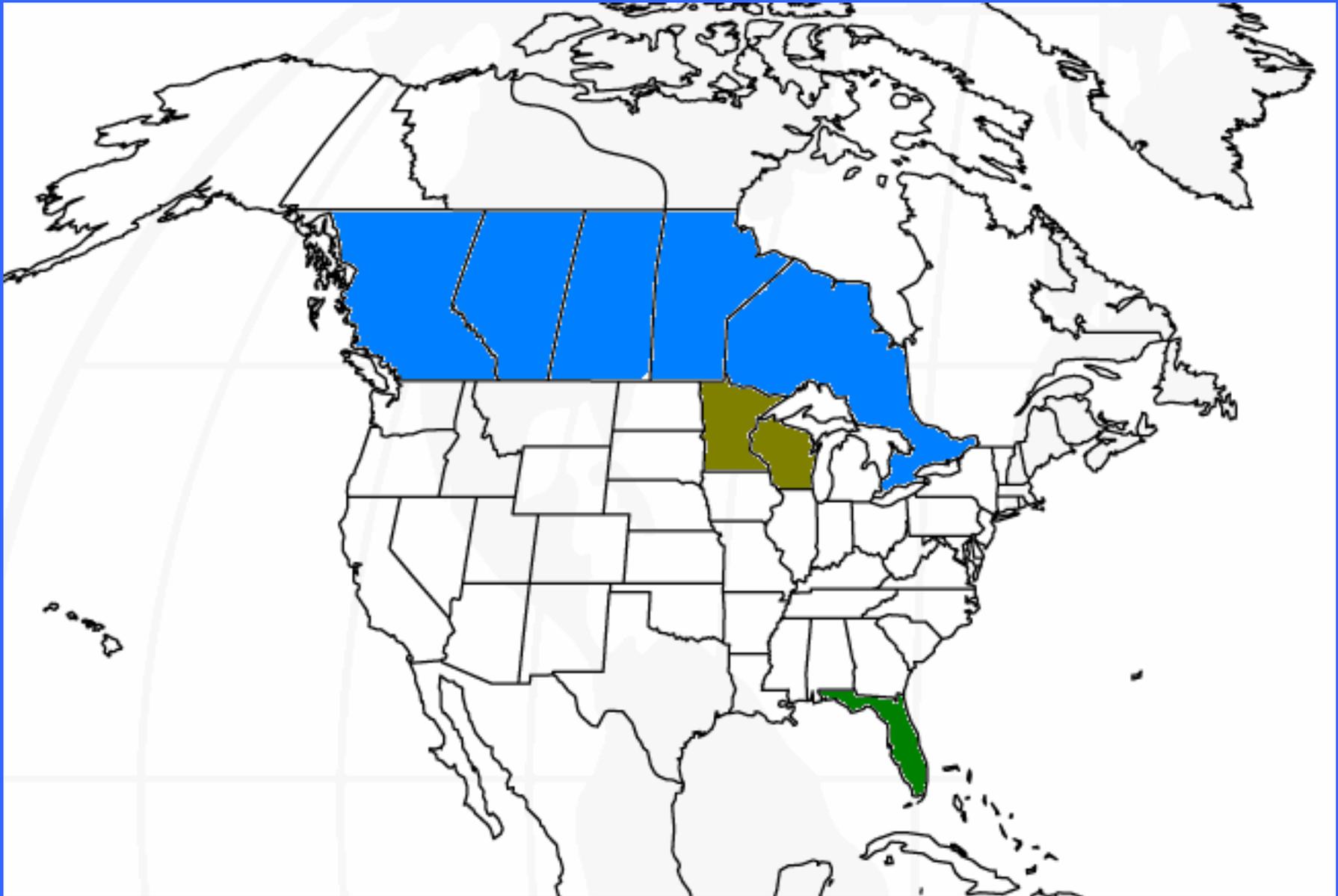


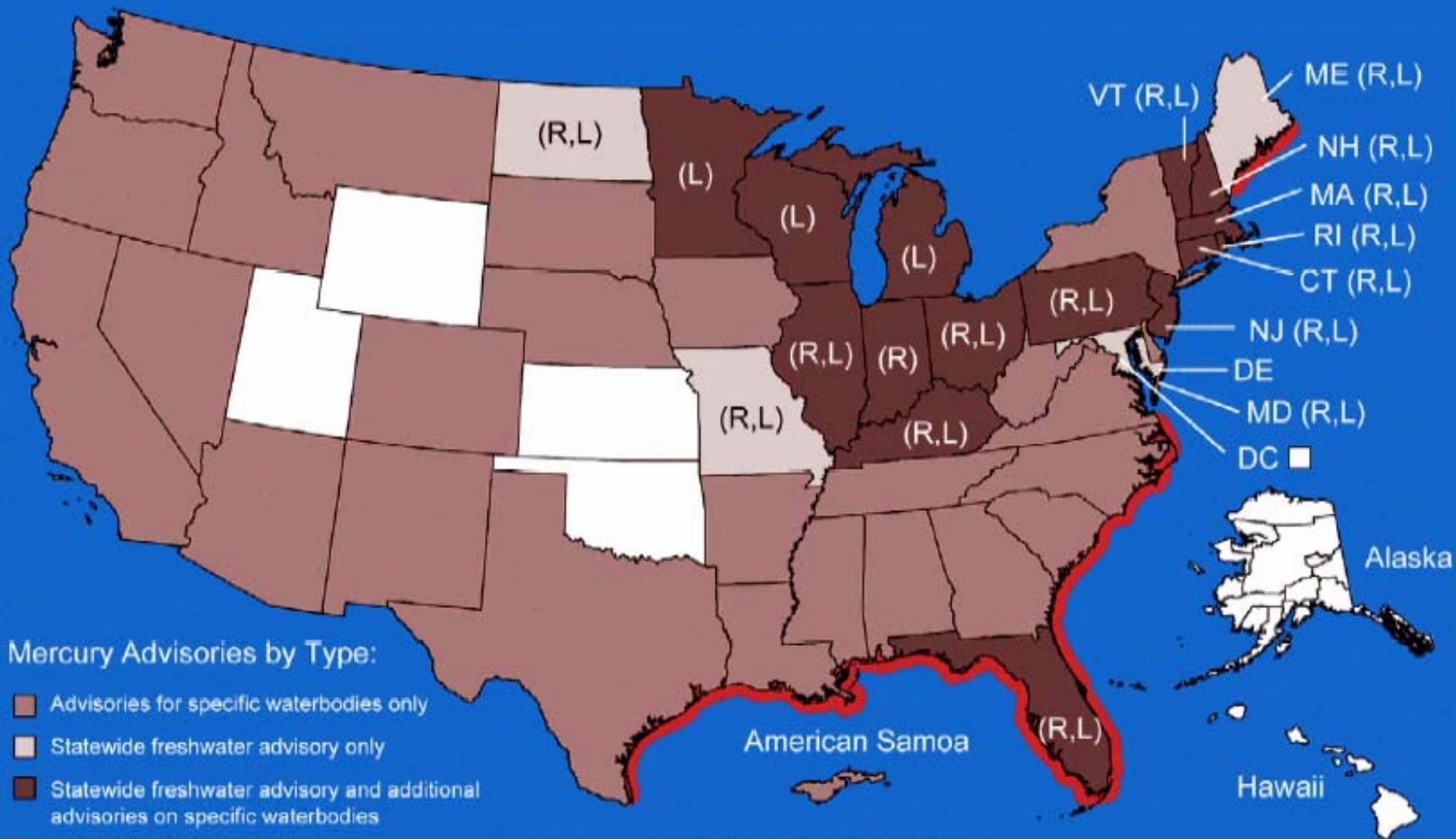
W. Palm Beach

Ft. Lauderdale

Miami







VT (R,L)
 ME (R,L)
 NH (R,L)
 MA (R,L)
 RI (R,L)
 CT (R,L)
 NJ (R,L)
 DE
 MD (R,L)
 DC ■

Mercury Advisories by Type:

- Advisories for specific waterbodies only
- Statewide freshwater advisory only
- Statewide freshwater advisory and additional advisories on specific waterbodies
- Statewide coastal advisory
- No mercury advisories

R = All rivers under advisory
 L = All lakes under advisory

MERCURY

~1990 THE PROBLEM

SENTINEL RECEIVED AUG 17 1989
THURSDAY, August 10, 1989
ENVIRONMENTAL HAZARDS
EPIDEMIOLOGY

High mercury levels taint S. Florida fish
BROWARD METRO
Sunday, September 15, 1991 \$1

Mercury in North Florida fish too high
By Carrie Teegardin
Democrat staff writer

Mercury pollutes 3 top fishing lakes
Commission fisheries research chief. Only bass were...
...limit the amount of...
...0.5 part per mil...
...health and Rehabil...
...of...
...us or...

State officials: Mercury's effect on health unclear
One mistake was telling pregnant women to limit consumption of mercury-tainted fish. In fact, all women of childbearing age are supposed to limit the mercury-laden fish they eat.
Another problem with the early advice was that it was based on the early data that half a pound of fish was safe to eat. As many people felt safe in eating several pounds of fish a week, that's what they were doing.

Mercury in YOUR WALLET

Mercury in North Florida fish too high
MIAMI — The...
...into uncharted...
...provide the federal...
...broadest test yet of...
...ment applies to gov...
...against foreign citizen...
...The criminal case is s...
...opening statement b...
...nt on Monday morning...
...the historic drug-trai...
...eetering trial has bee...
...reuters as just another...
...constitutional scholars...
...say the Noriega cas...
...it routine...
...say that if Noriega is co...
...conviction is appeal...
...eme Court and upheld...
...tely to establish uphel...
...give U.S. milit...
...officials



MERCURY

The Problem

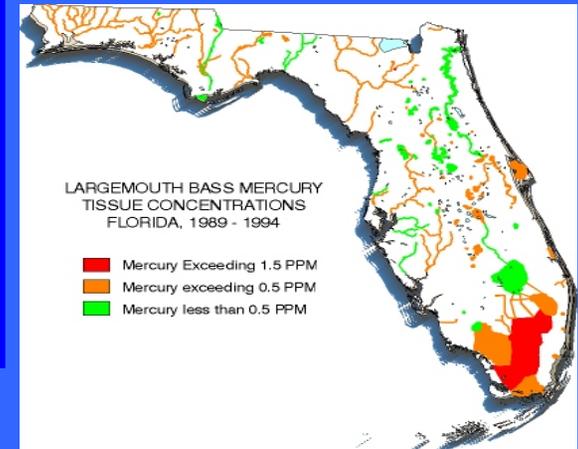


WARNING

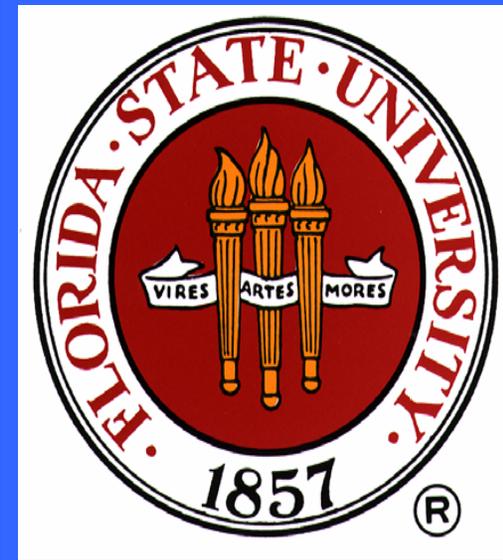
The Florida Department of Health and Rehabilitative Services has issued a health advisory urging limited consumption of largemouth bass and warmouth caught in certain portions of the Everglades due to excessive accumulation of the element mercury.

- Fish caught in Arthur R. Marshall Loxahatchee National Wildlife Refuge (Water Conservation Area 1) should not be eaten more than once per week by adults and not more than once per month by children under 15 and pregnant women.
- Fish caught in Water Conservation Areas 2a and 3 should not be eaten at all.

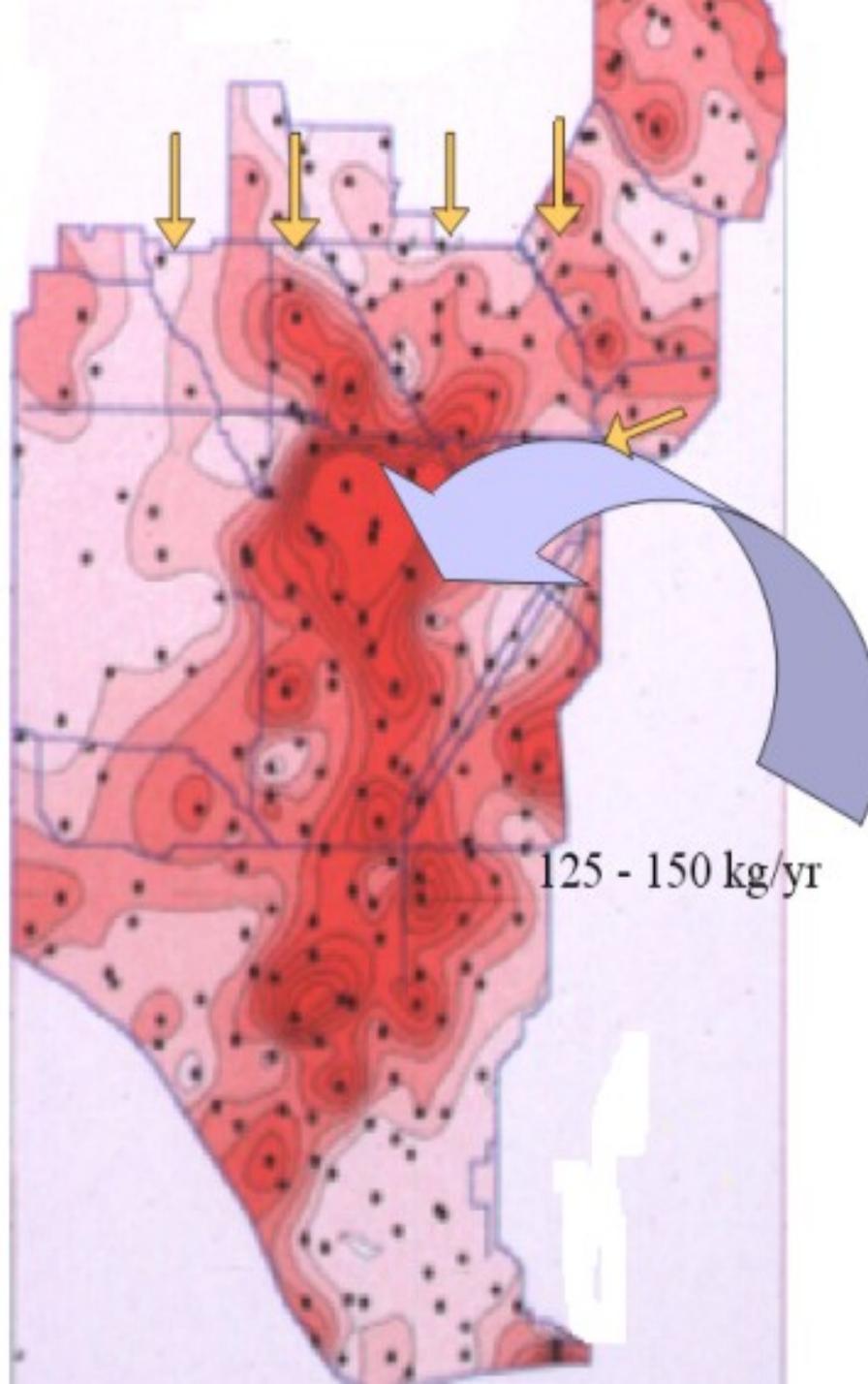
For additional information, contact the Florida Department of Health and Rehabilitative Services at (405) 355-3018.



Science Partners

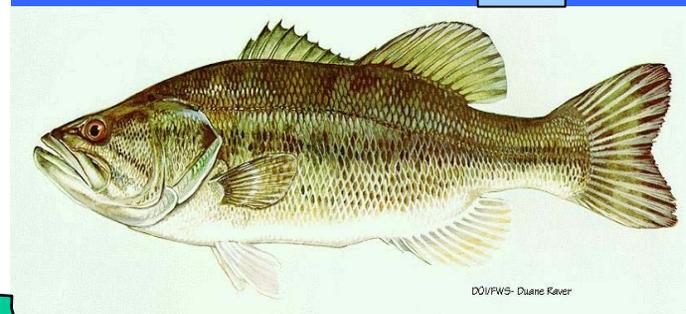
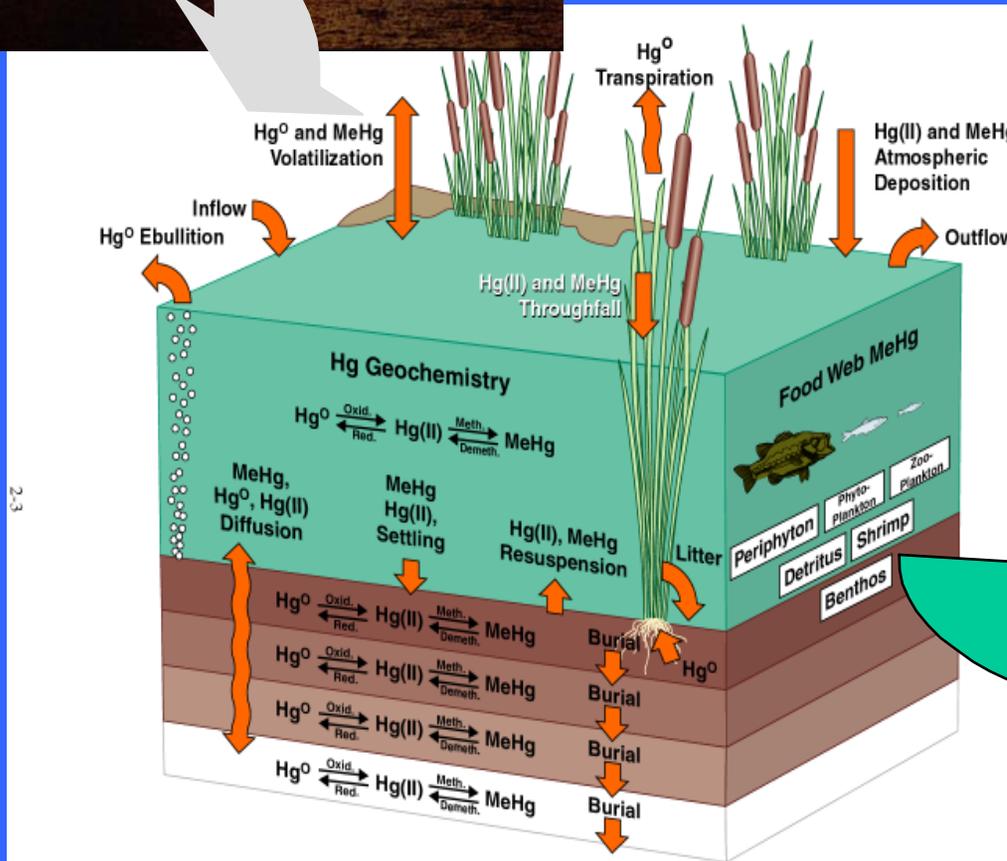






125 - 150 kg/yr

~ 98 %
Atmospheric



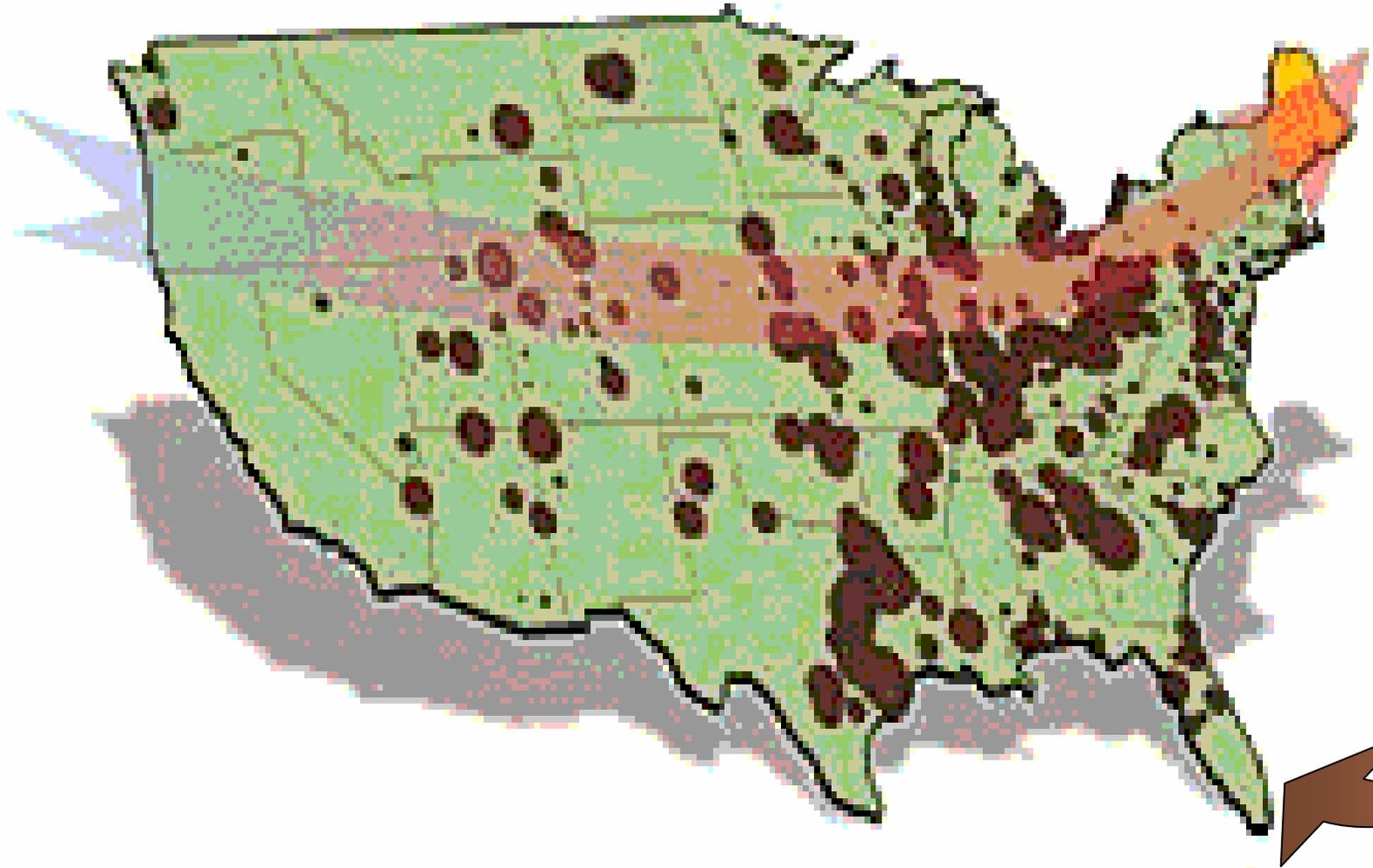
DOI/FWS- Duane Kaver

Figure 1. Conceptual model of Hg cycle in Everglades Hg Model

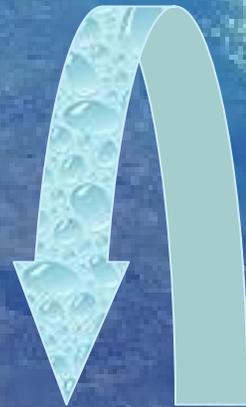
The Mercury Problem

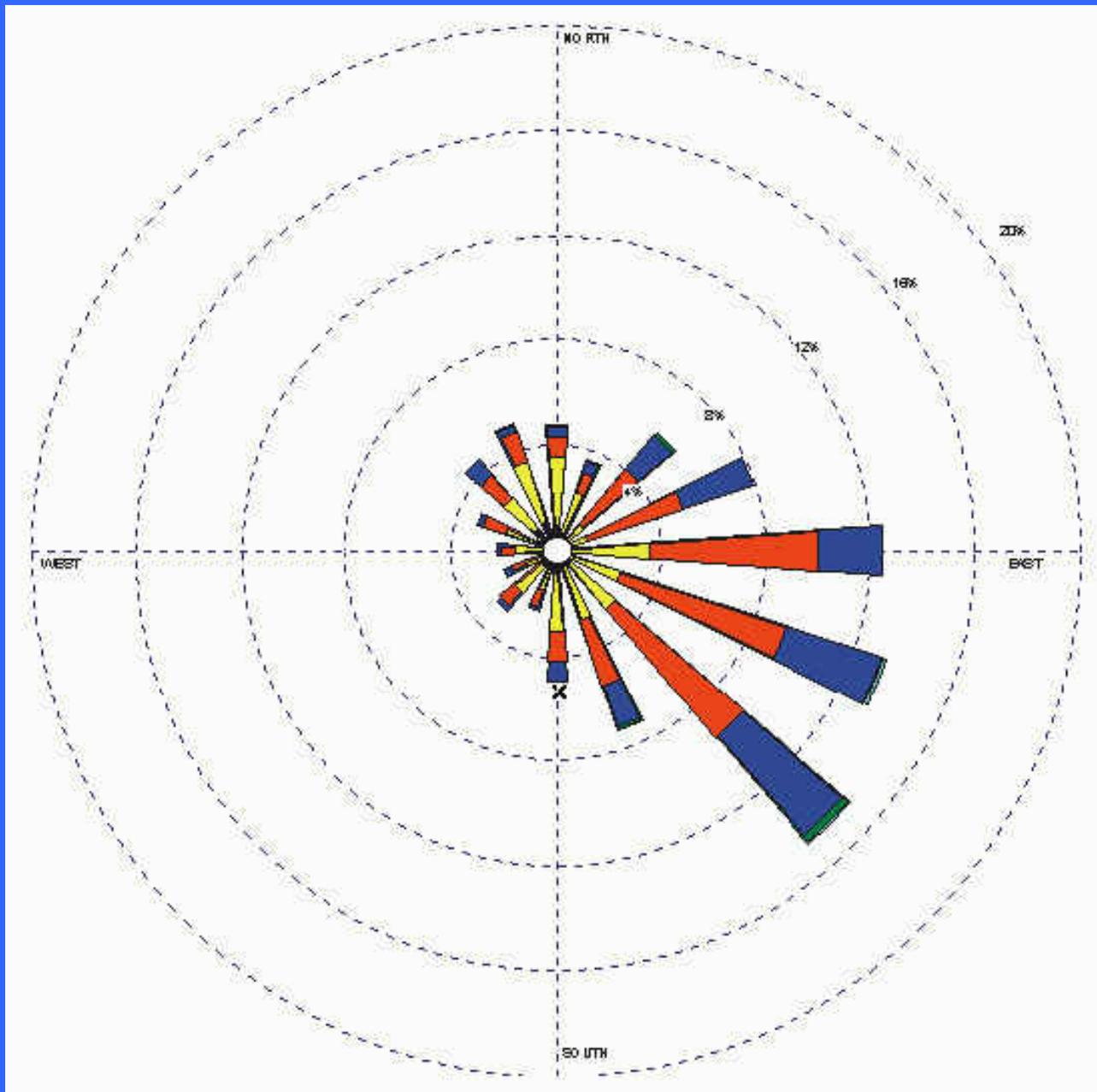
Where does the mercury come from?

Mercury Emission and Transport



~ 60% Local Sources





Wind Rose: Miami, Fla., Summer 6 mos., 1992



Municipal Waste Combustor

W

E

 **PREVAILING WINDS**

WET DEPOSITION

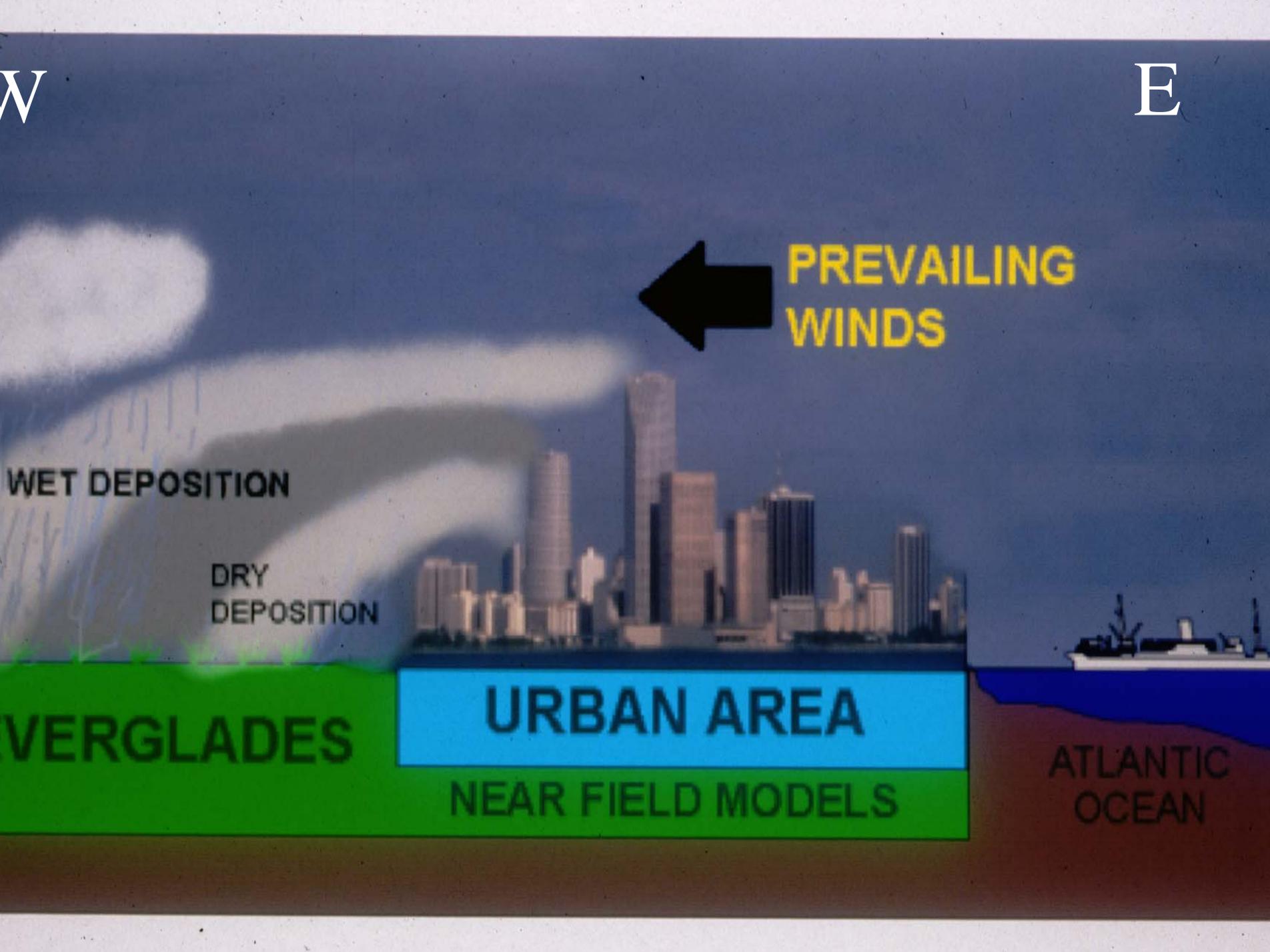
DRY DEPOSITION

VERGLADES

URBAN AREA

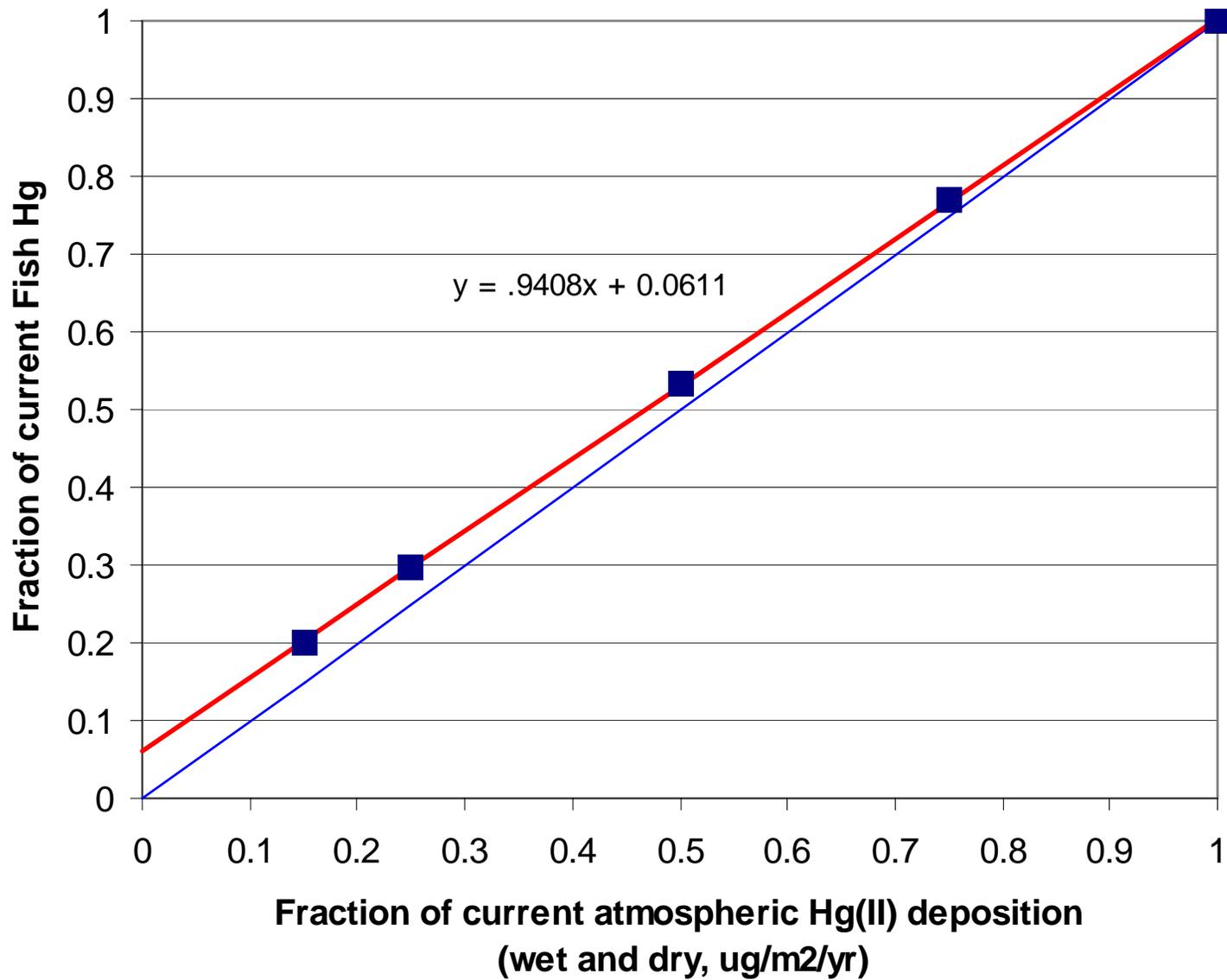
NEAR FIELD MODELS

ATLANTIC OCEAN

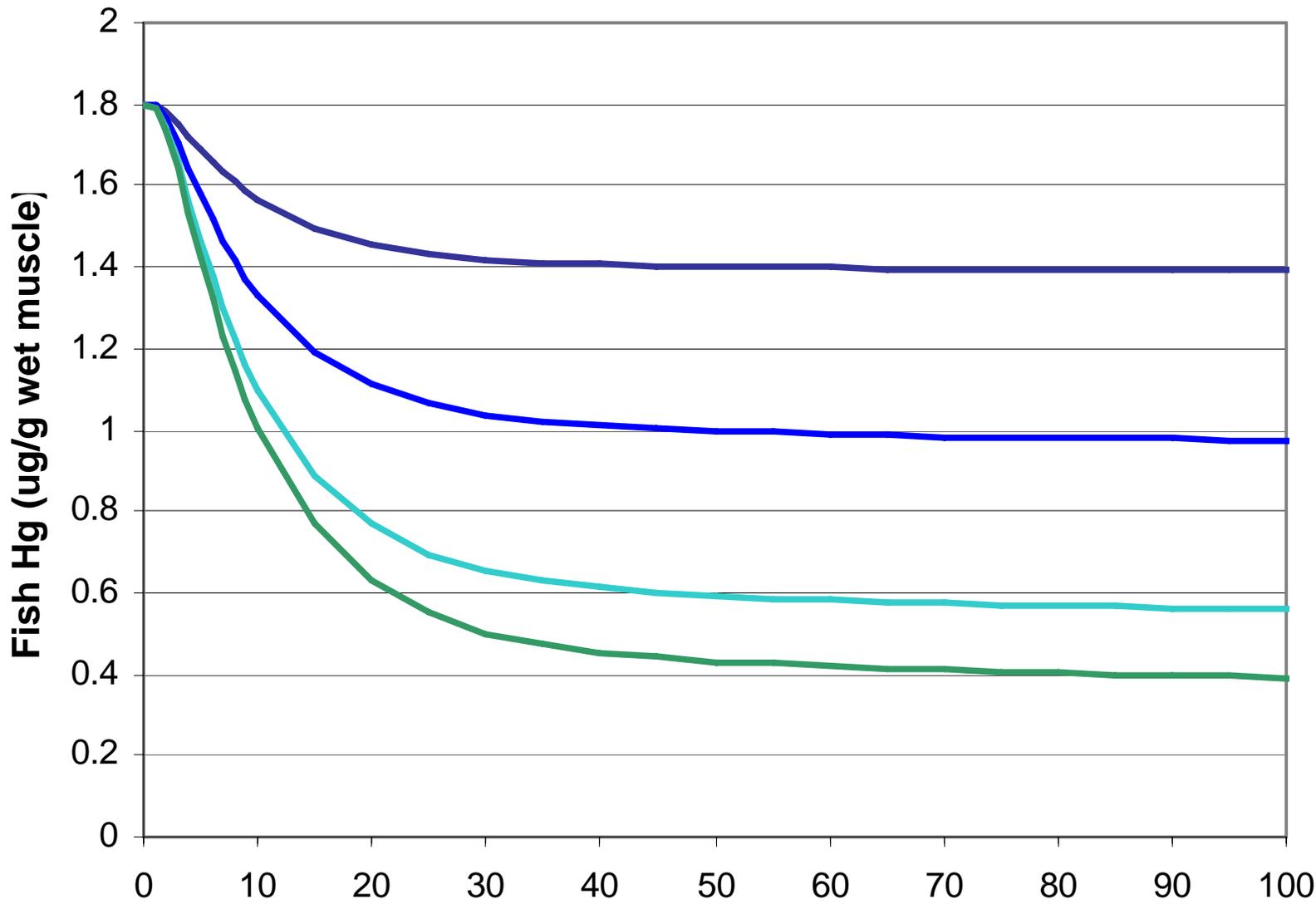


Mercury Trends

Recent Data From Florida



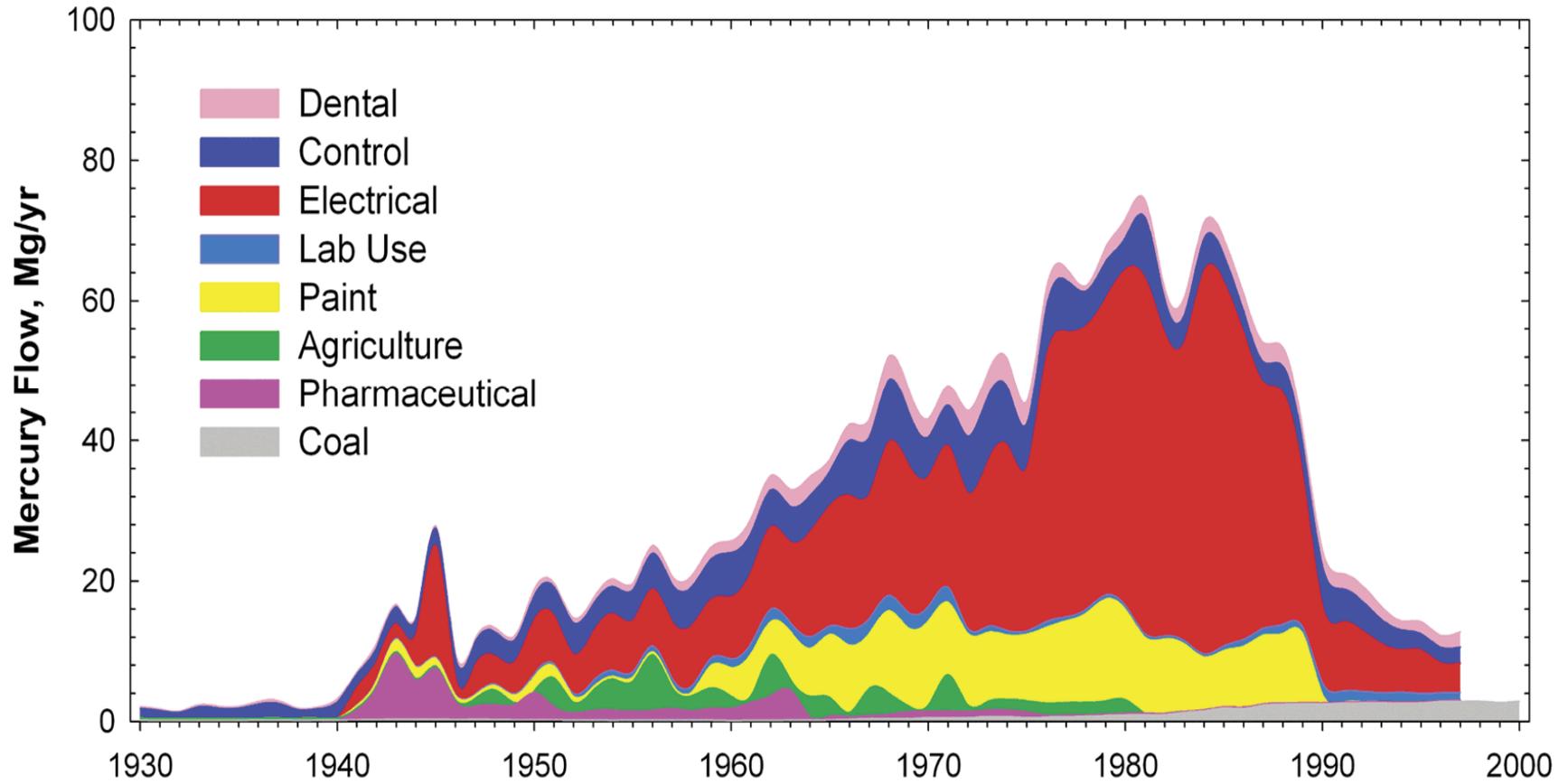
— Proportional response ■ E-MCM predicted — Linear fit of E-MCM results



— 25% Reduction — 50% Reduction — 75% Reduction — 85% Reduction

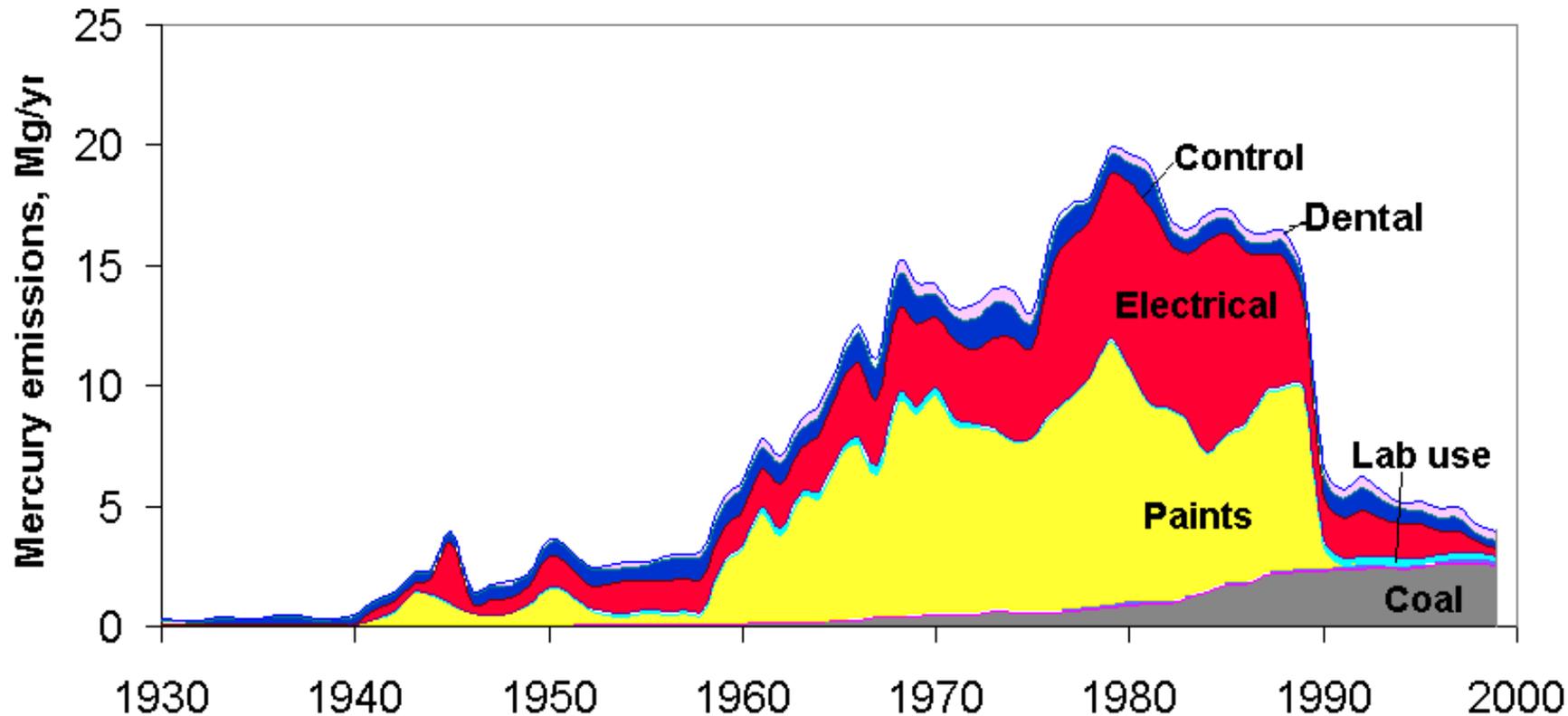
MERCURY

Material Flows in Florida



MERCURY Retrospective Emission Inventory

Trend of anthropogenic Hg emissions in Florida



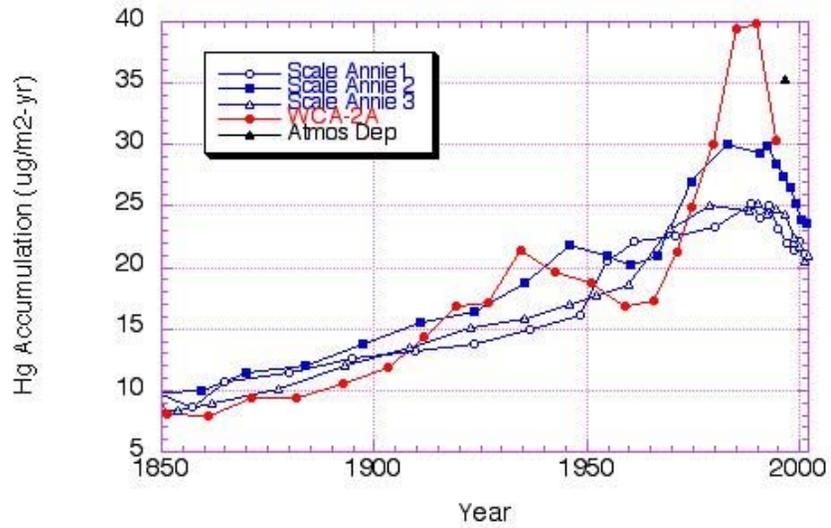
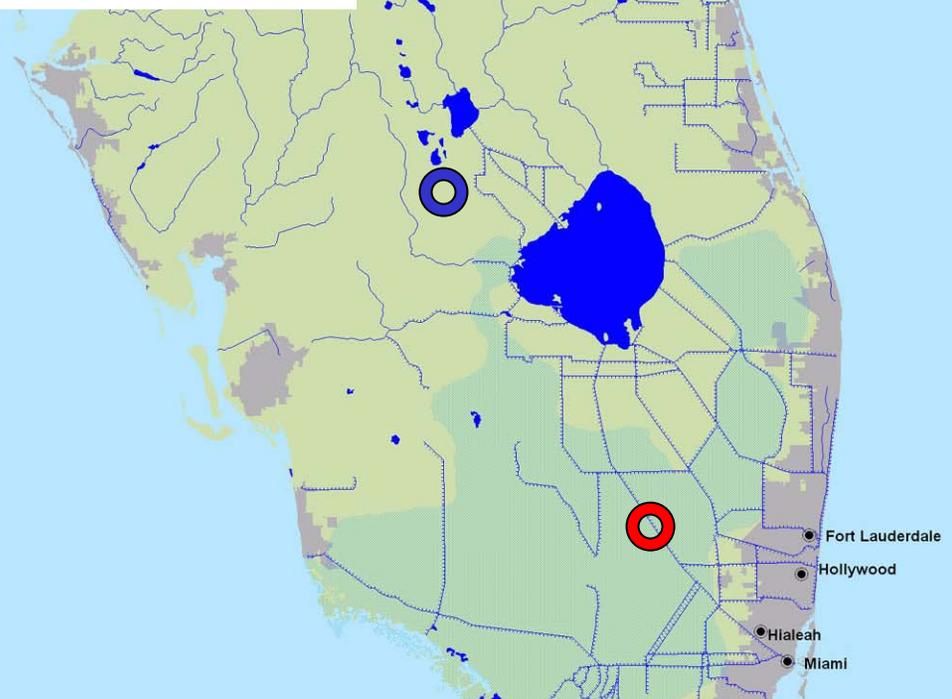
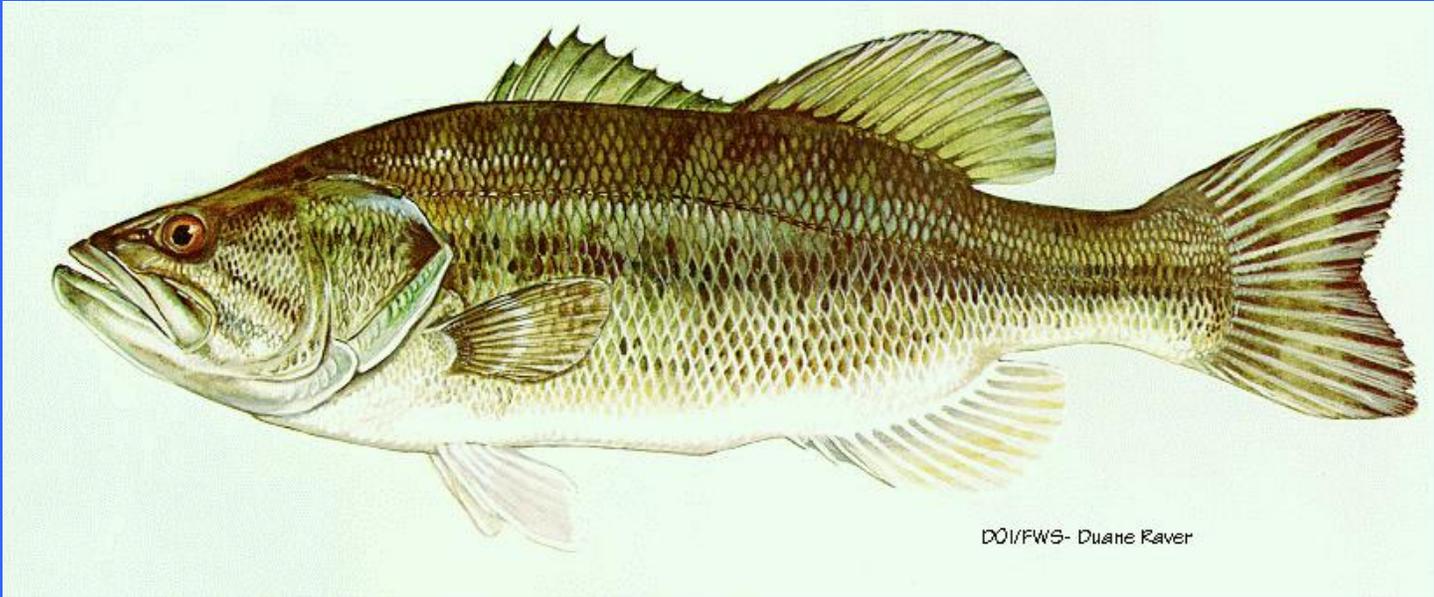


Figure 2. Same as Figure 1, except that the Lake Annie fluxes have been normalized to yield similar baseline (pre-1850) fluxes as Site F3.

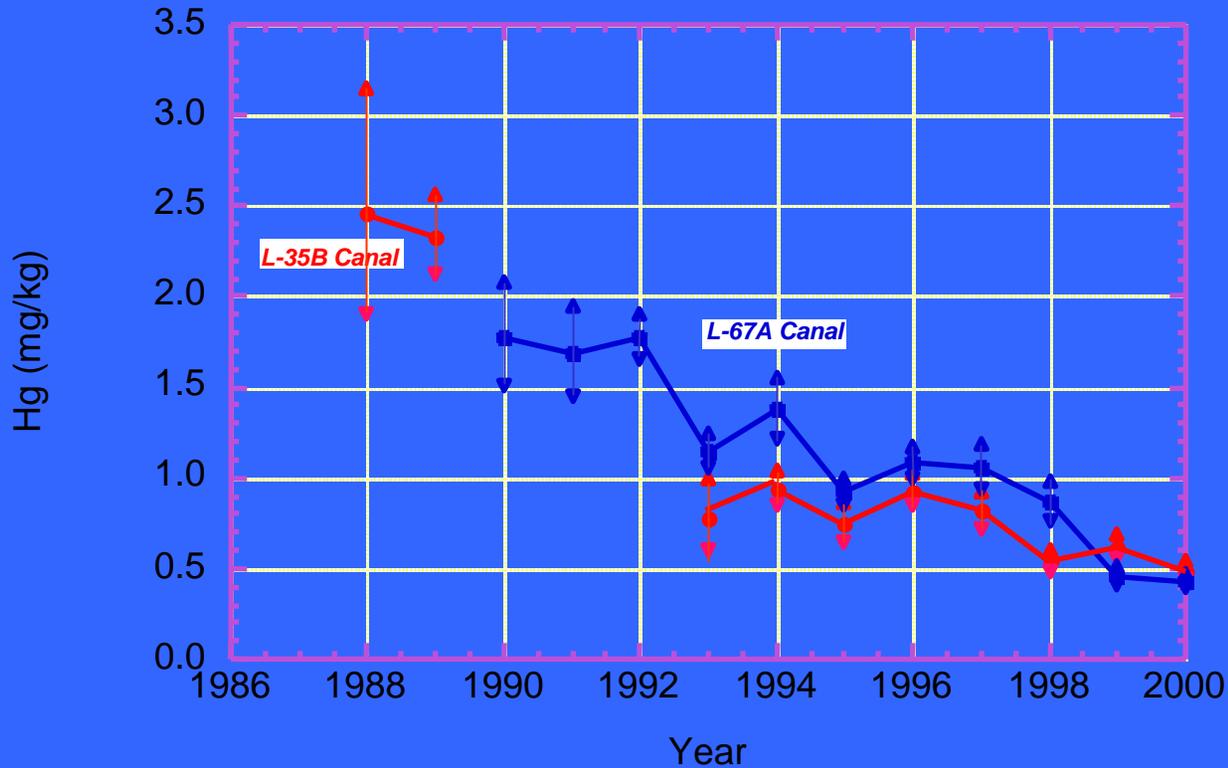




DOI/FWS- Duane Kaver

Hg Concentrations in Largemouth Bass Everglades Canals L-37B and L-67A

Geometric mean by year. Diamonds show ± 1 SE of the Mean

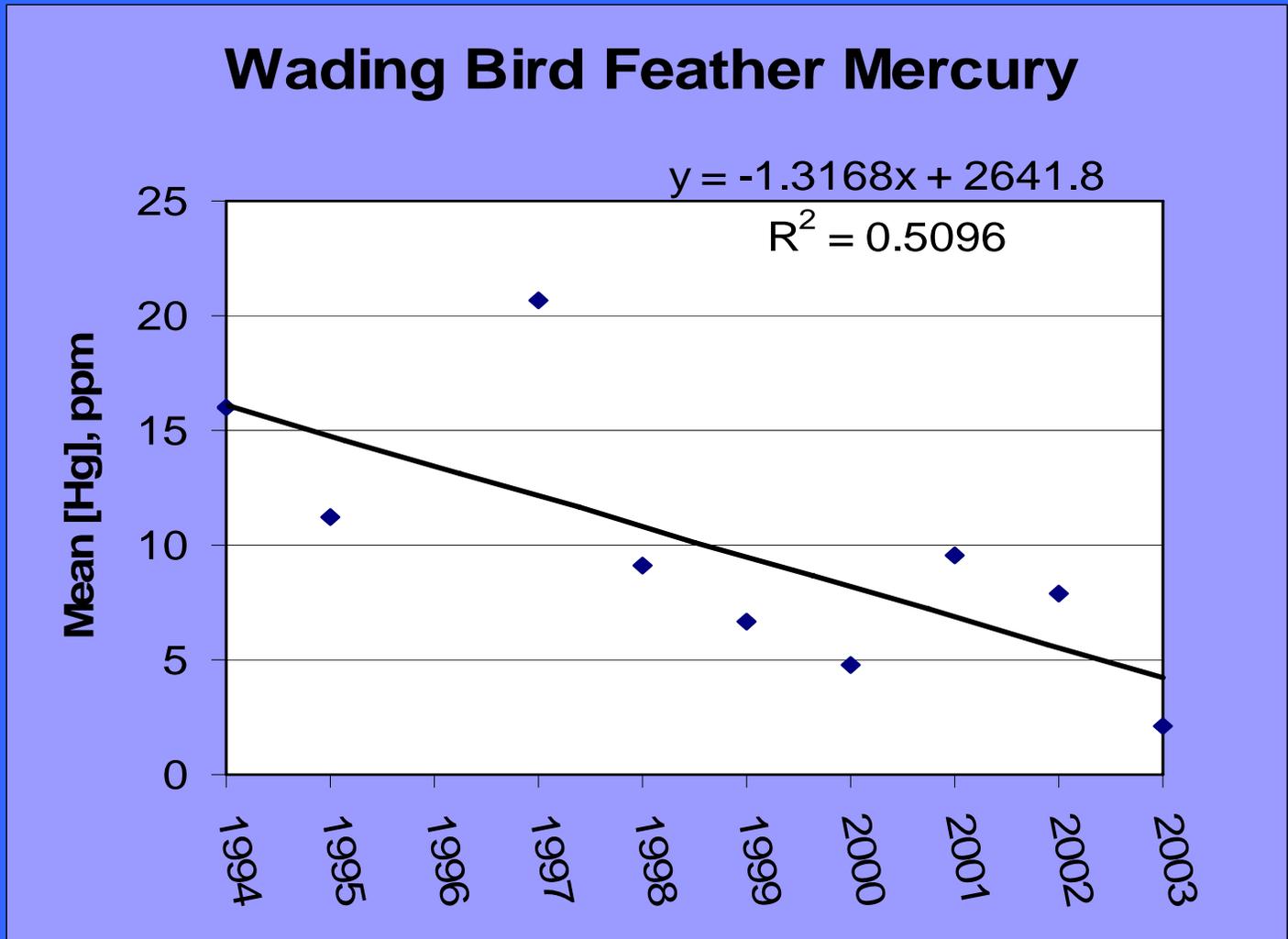


Data courtesy of Ted Lange.

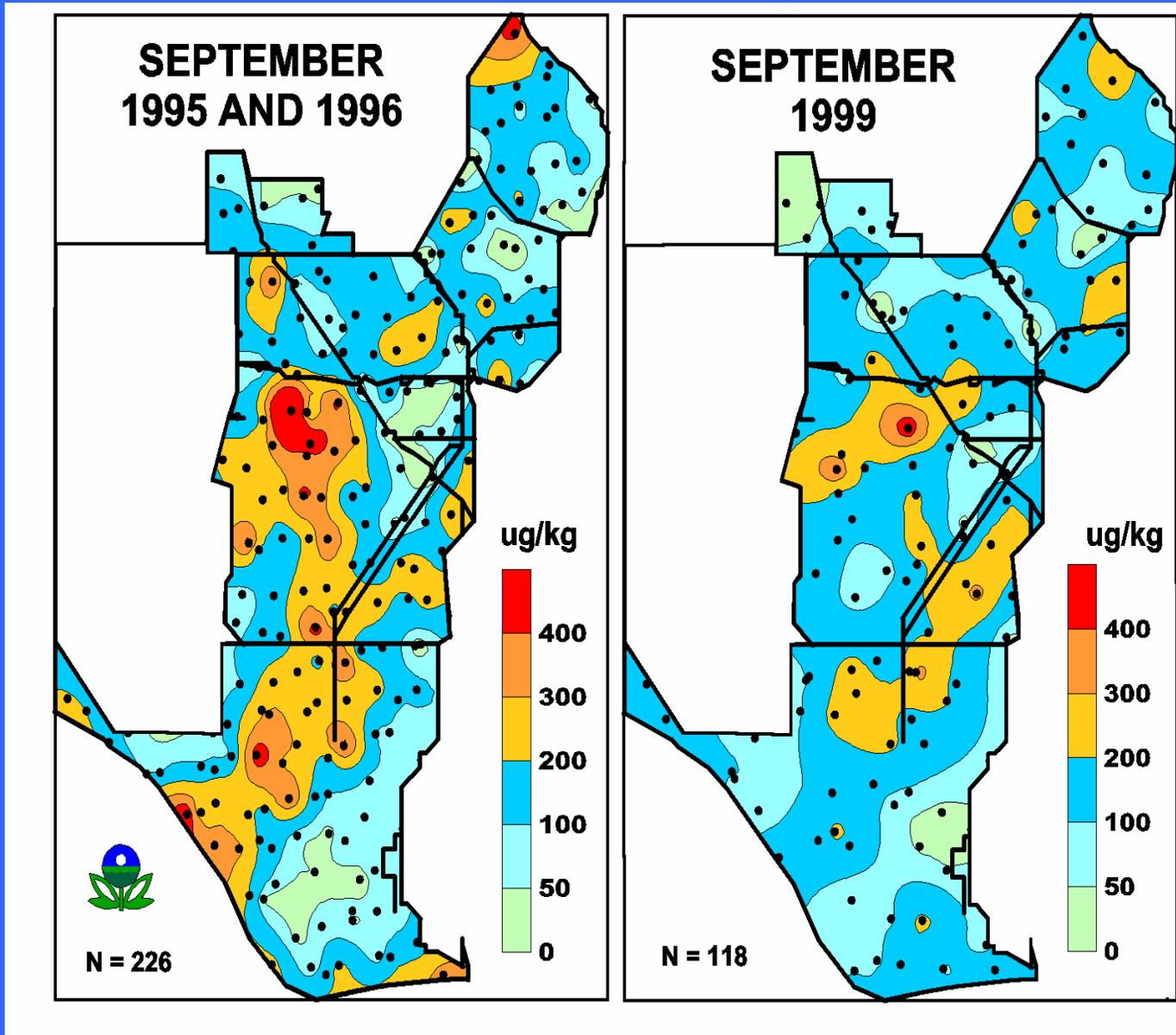


MERCURY

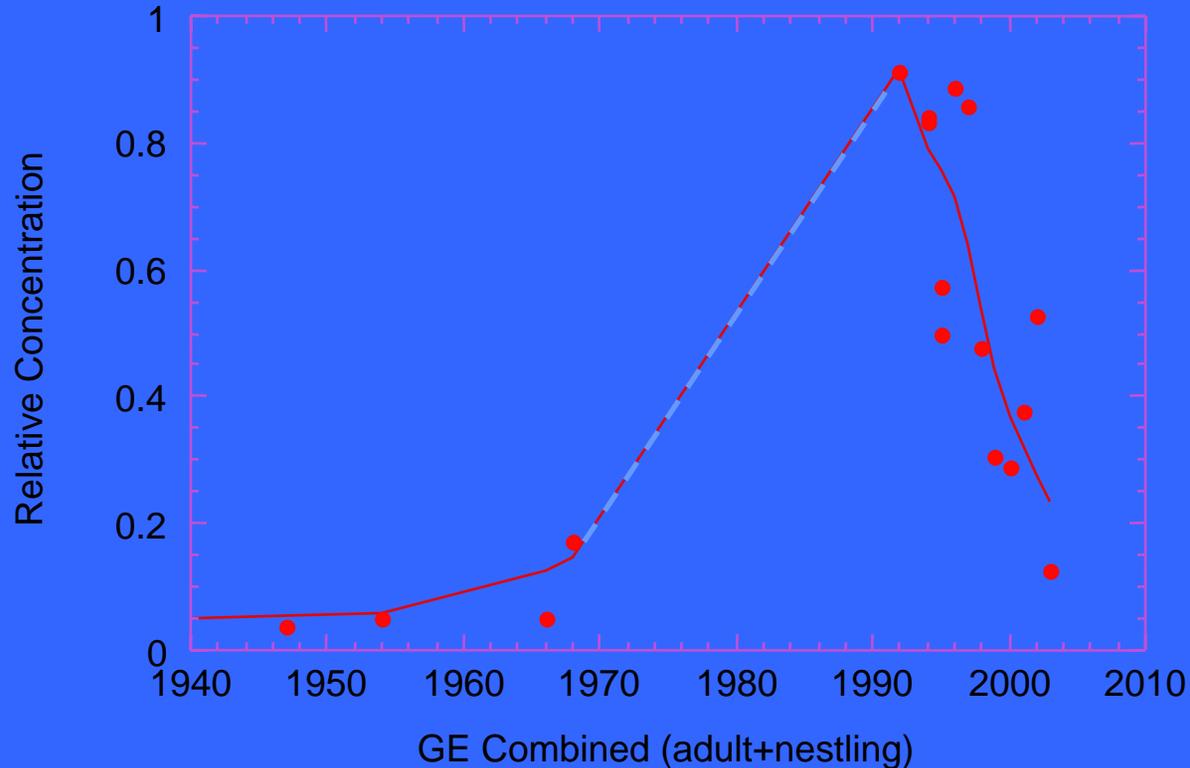
Great Egret Feathers, 94 - 03 All Active Nesting Colonies



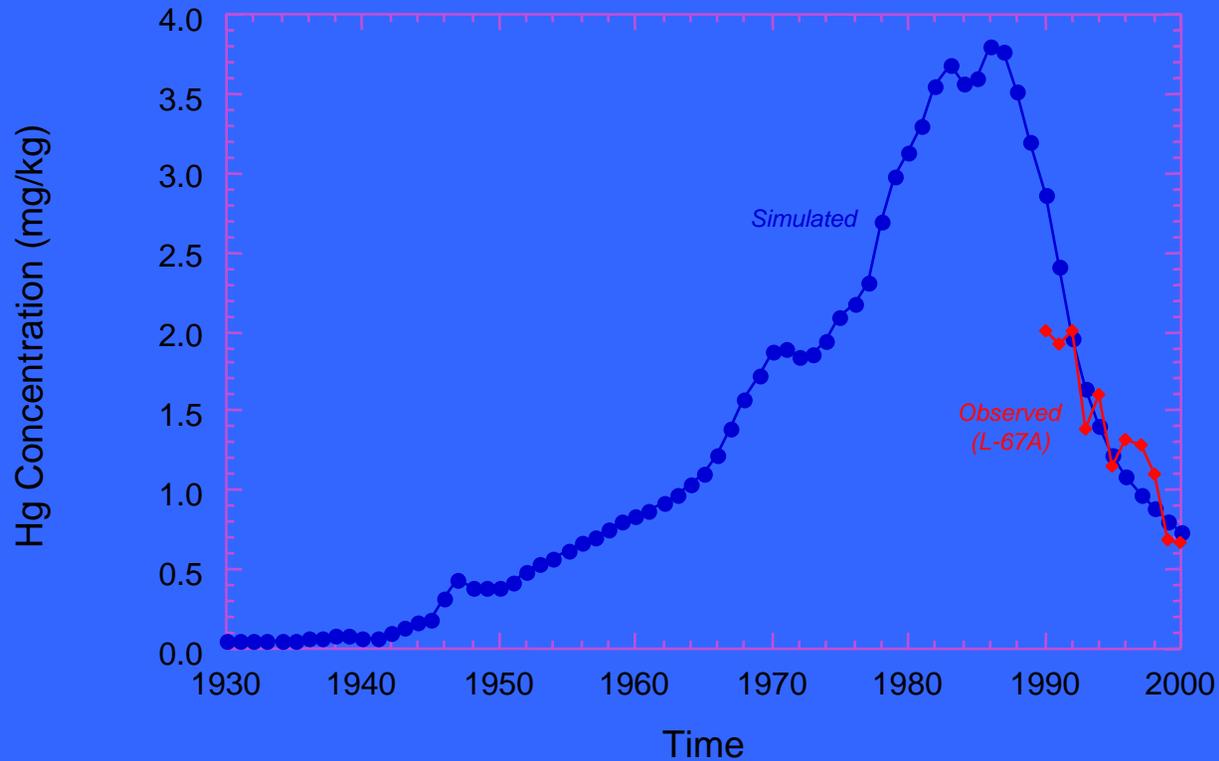
MOSQUITOFISH Hg TREND



Concentrations of Hg in Great Egret Feathers (adults and nestlings). Data normalized to facilitate comparison. Data courtesy of P. Frederick (2003).



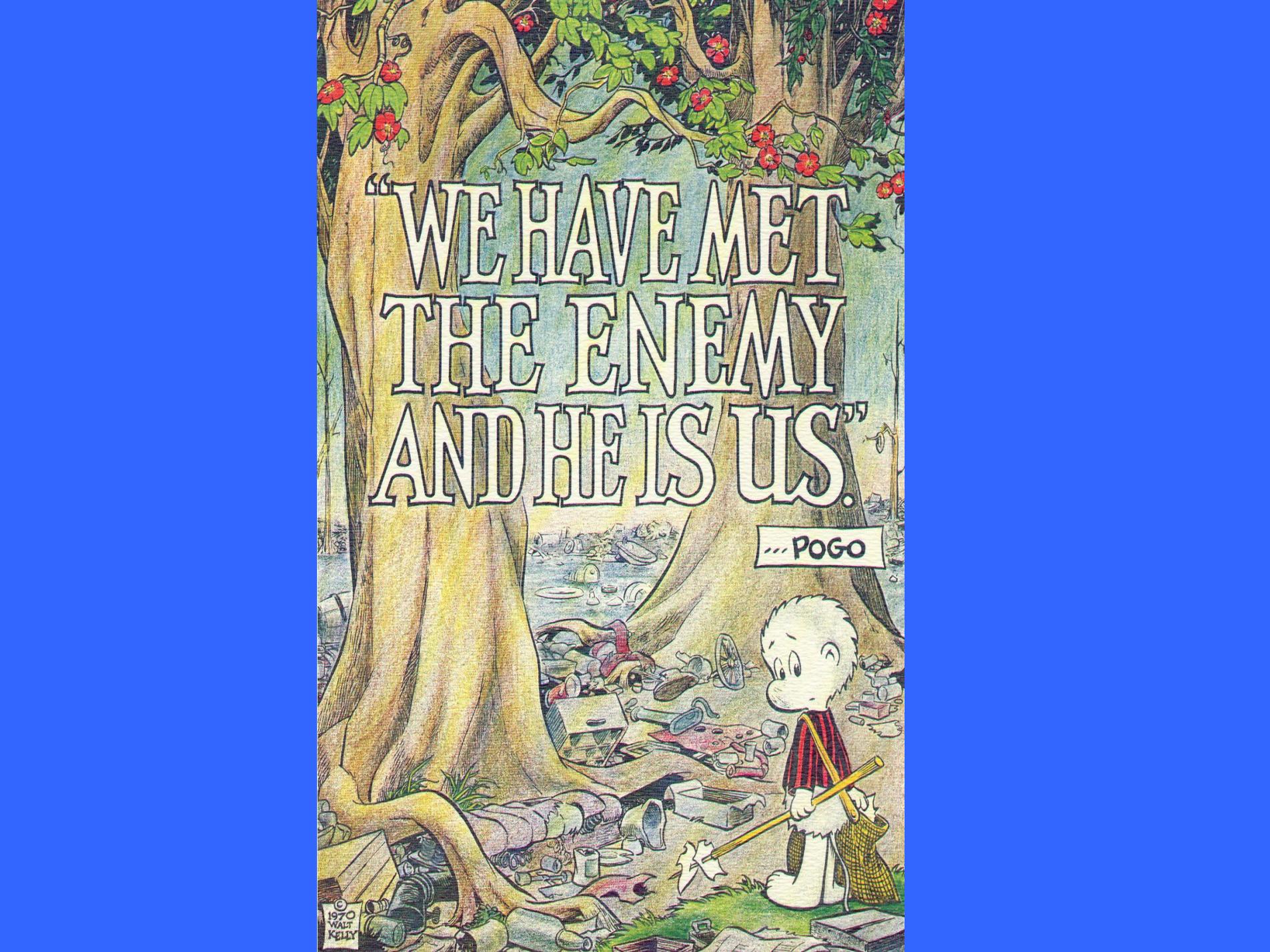
Preliminary E-MCM Model Hindcast of Changes in Hg Concentrations in Age 3 LMB Due to Inferred Changes in Atmospheric Deposition





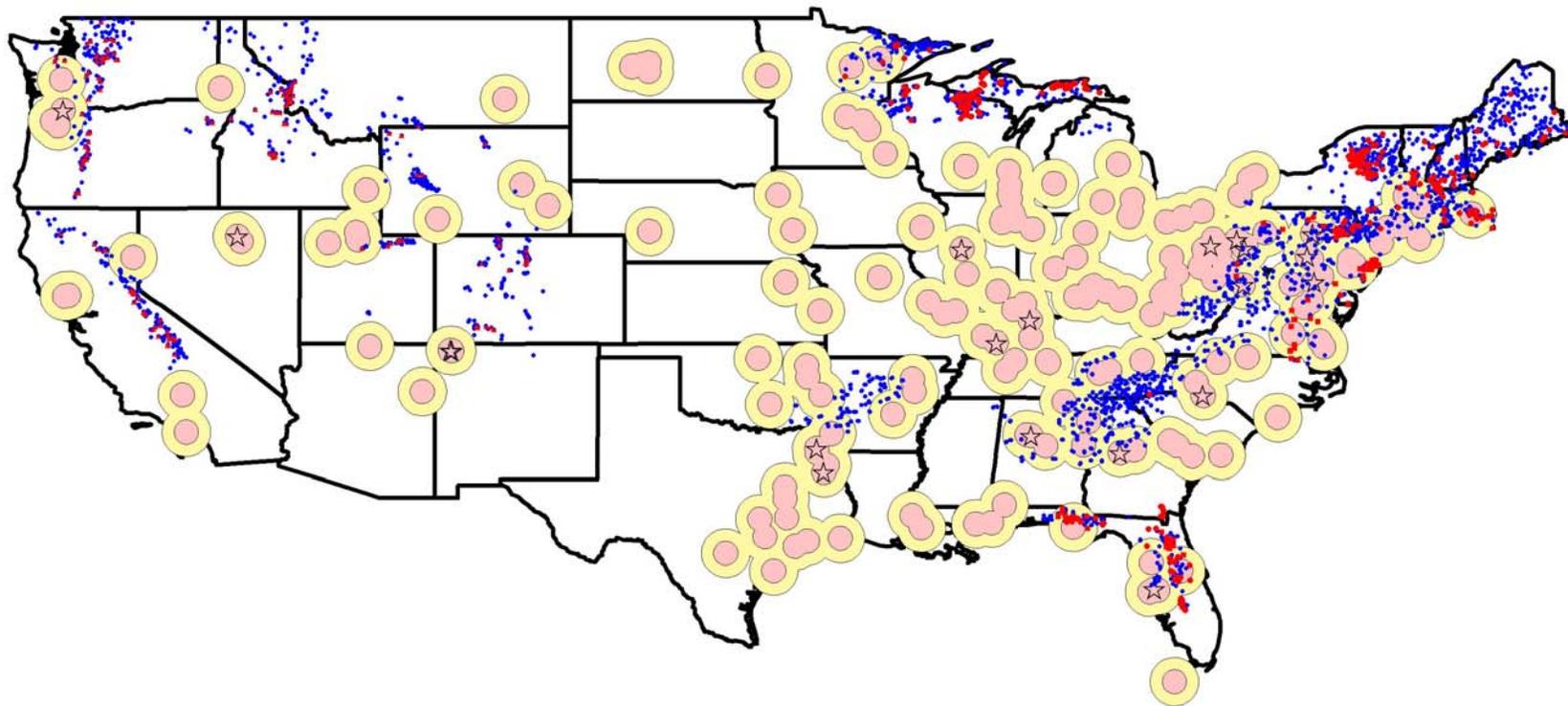
MERCURY : The Bottom Line

- Reduction of atmospheric sources of mercury within Florida has led to > 60% declines in mercury in Everglades fish and wildlife in less than 15 years since peak deposition.
- To the extent that mercury emissions are in the reactive form (RGM), reductions will yield local-scale benefits within a few years, and near equilibrium in decades.
- The main driver of the Everglades mercury problem is mercury load – overwhelmingly from atmospheric deposition.
- There is synergy between Hg & Sulfate, which combine to exacerbate Hg methylation.



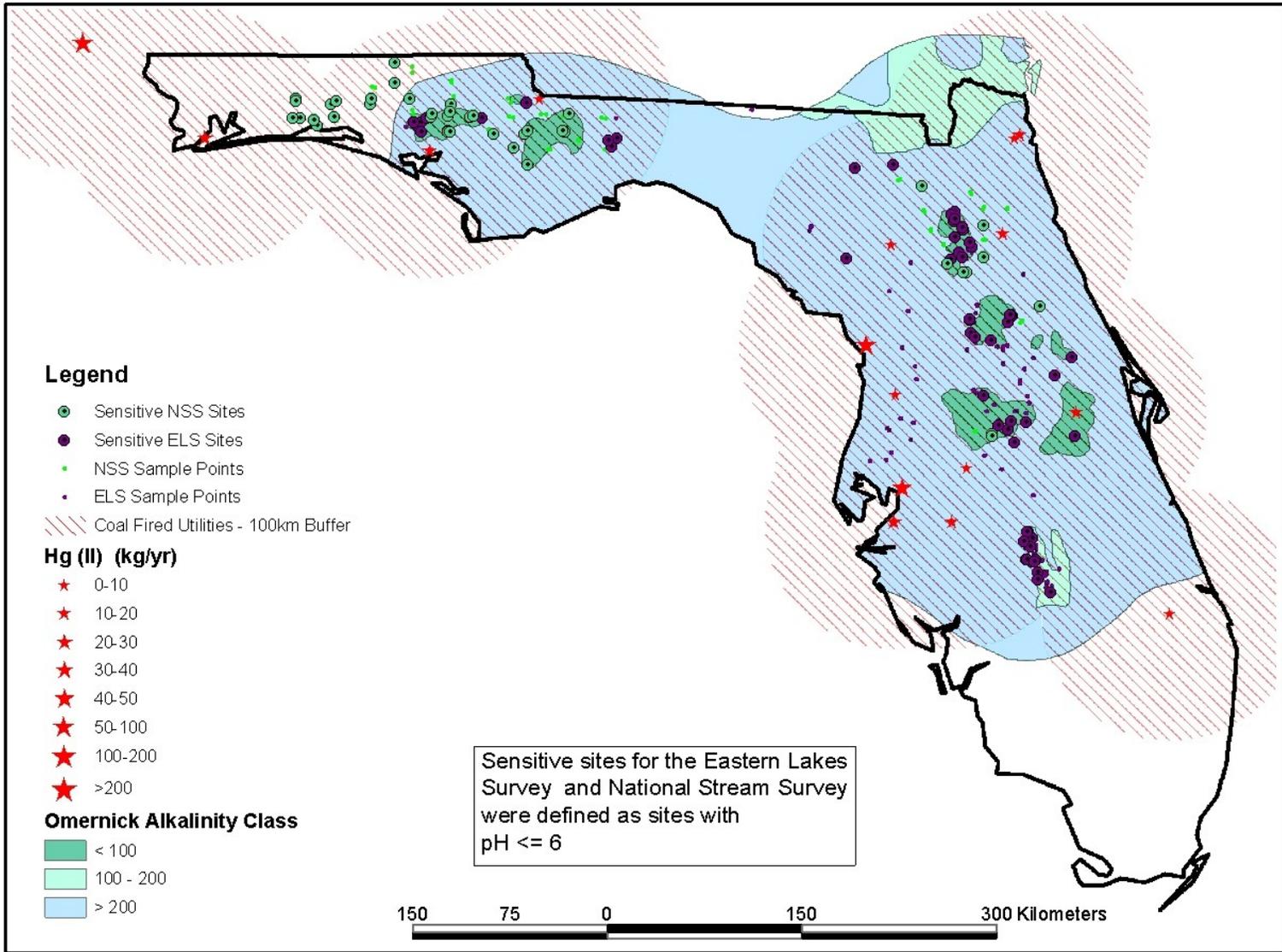
“WE HAVE MET
THE ENEMY
AND HE IS US.”

... POGO



- ▲ WLS - Sensi
 - NSS - Sensi
 - ELS - Sensi
 - ELS WLS and NSS sample points
- Top 200 Hg Emissions
- 50 km
 - 100 km
 - ☆ Top 20 Hg Emissions

Sensitive sites were selected from ELS and NLS by either $\text{pH} < 6.0$ or $\text{ANC} < 20$. NSS sites were selected with the same above criteria with an additional filter of $\text{DOC} > 3 \text{ mg/l}$.



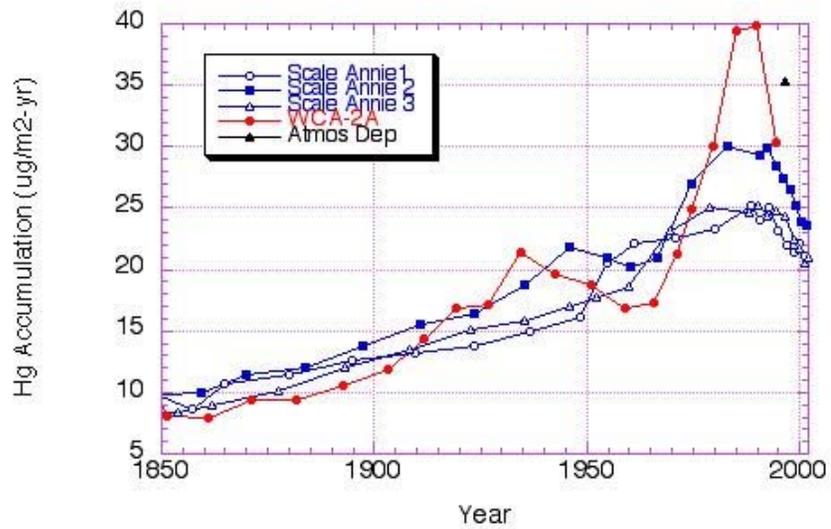
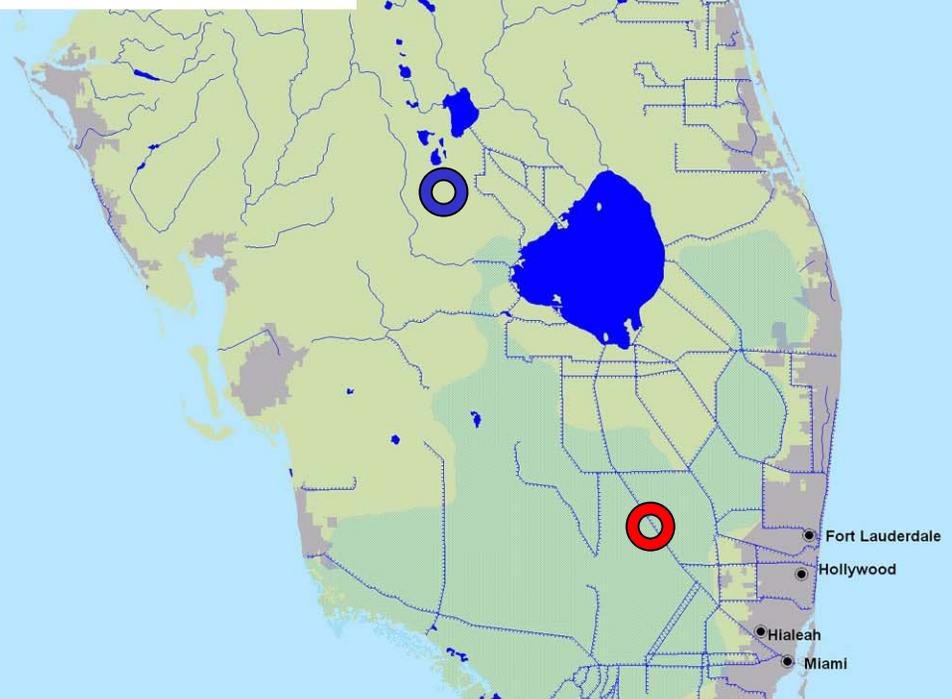
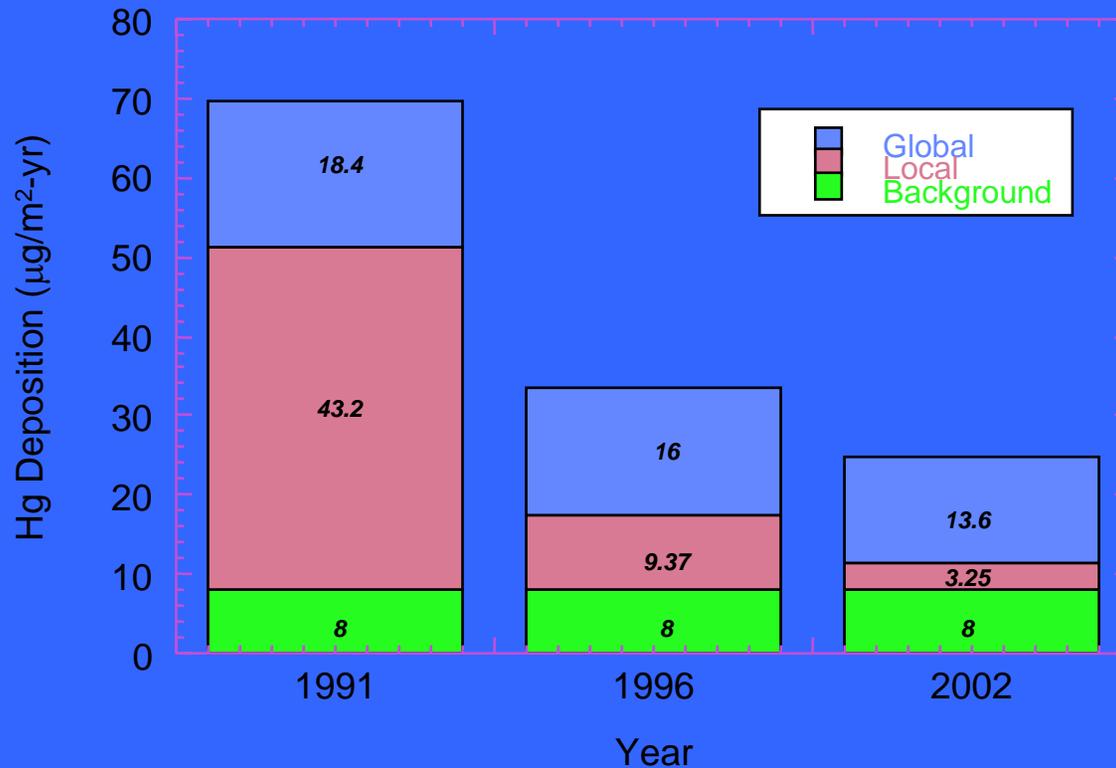


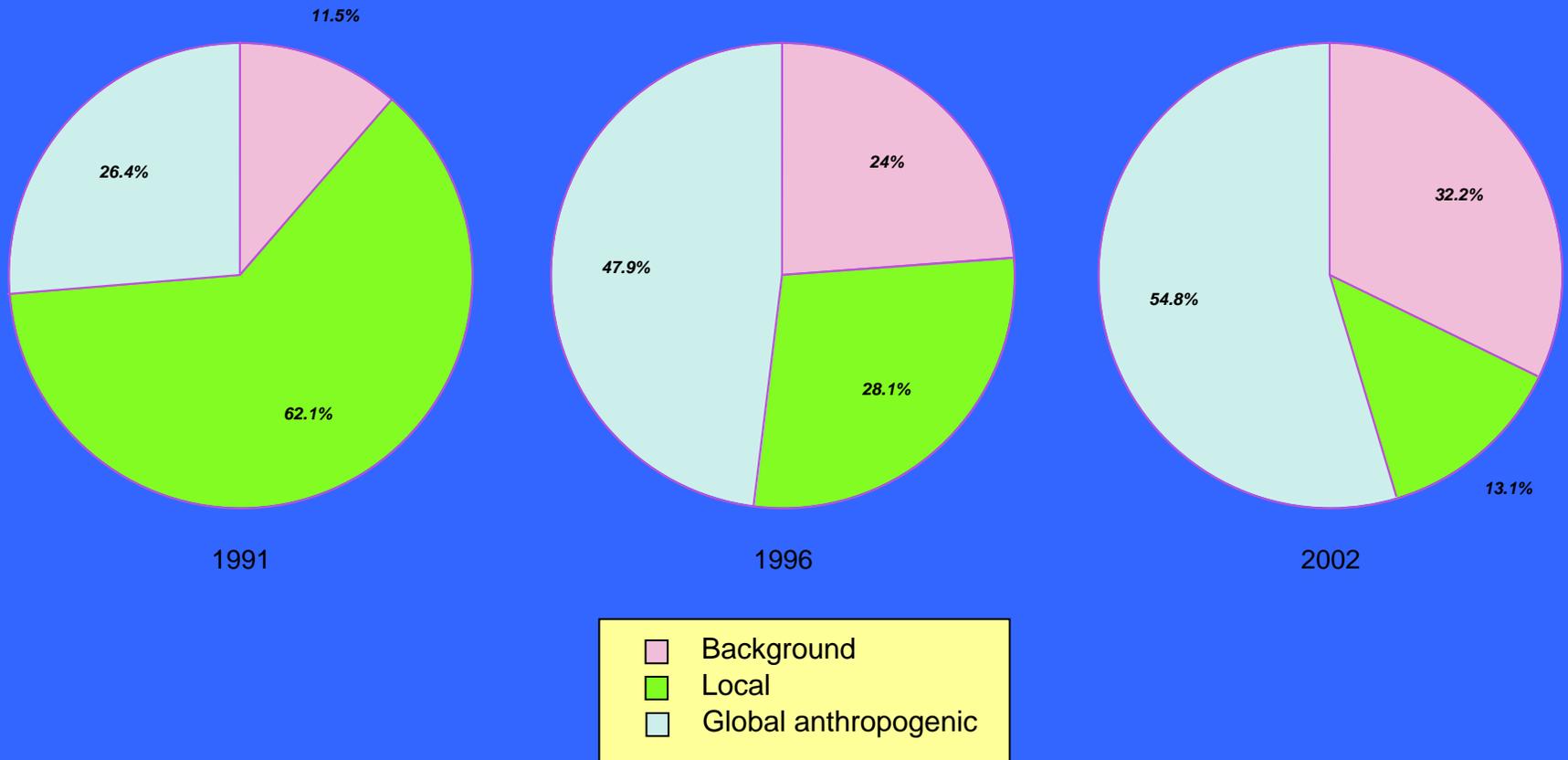
Figure 2. Same as Figure 1, except that the Lake Annie fluxes have been normalized to yield similar baseline (pre-1850) fluxes as Site F3.



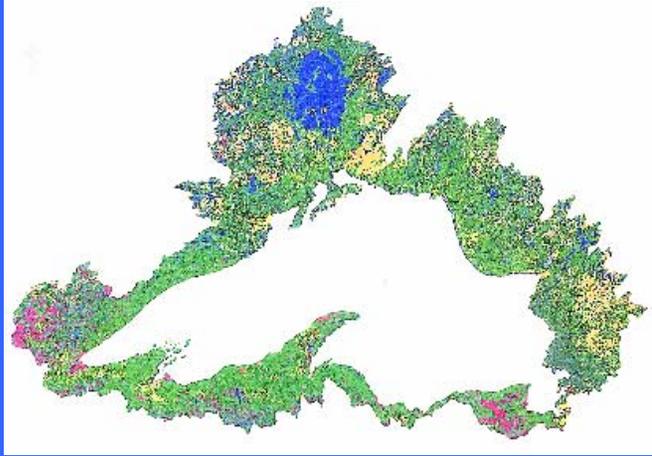
Changes in Local Emissions Contributions to Atmospheric Deposition Fluxes of Mercury in South Florida



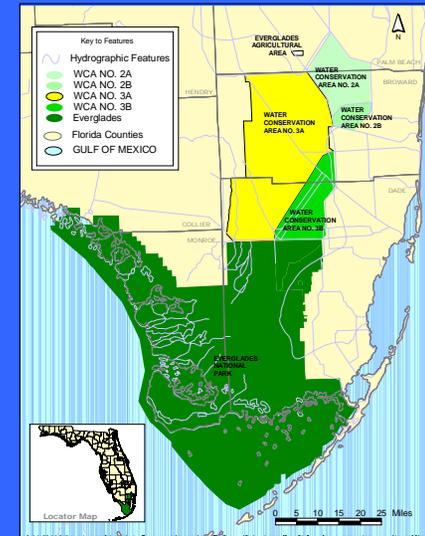
Changes in Local Emissions Contributions to Atmospheric Deposition Fluxes of Mercury in South Florida



End-members of mercury vulnerability



Vs.



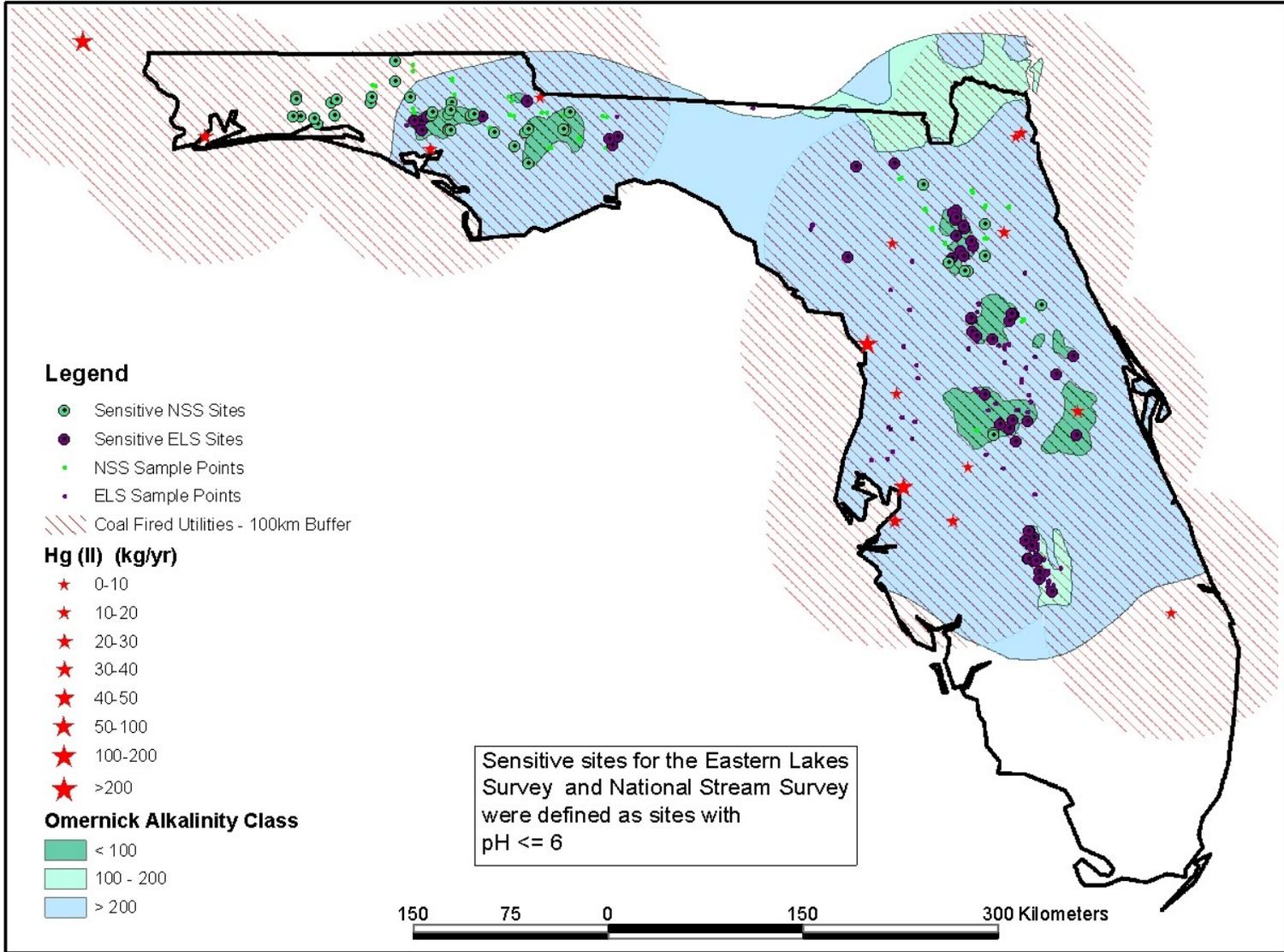
Lake Superior:

- Cold, prolonged ice-up
- Low photon flux
- Deep
- Disconnect w/ overlying epilimnion
- Low Surface to vol. Ratio
- ~ 100% wetlands
- Low surface roughness to trap atm. gases & particles

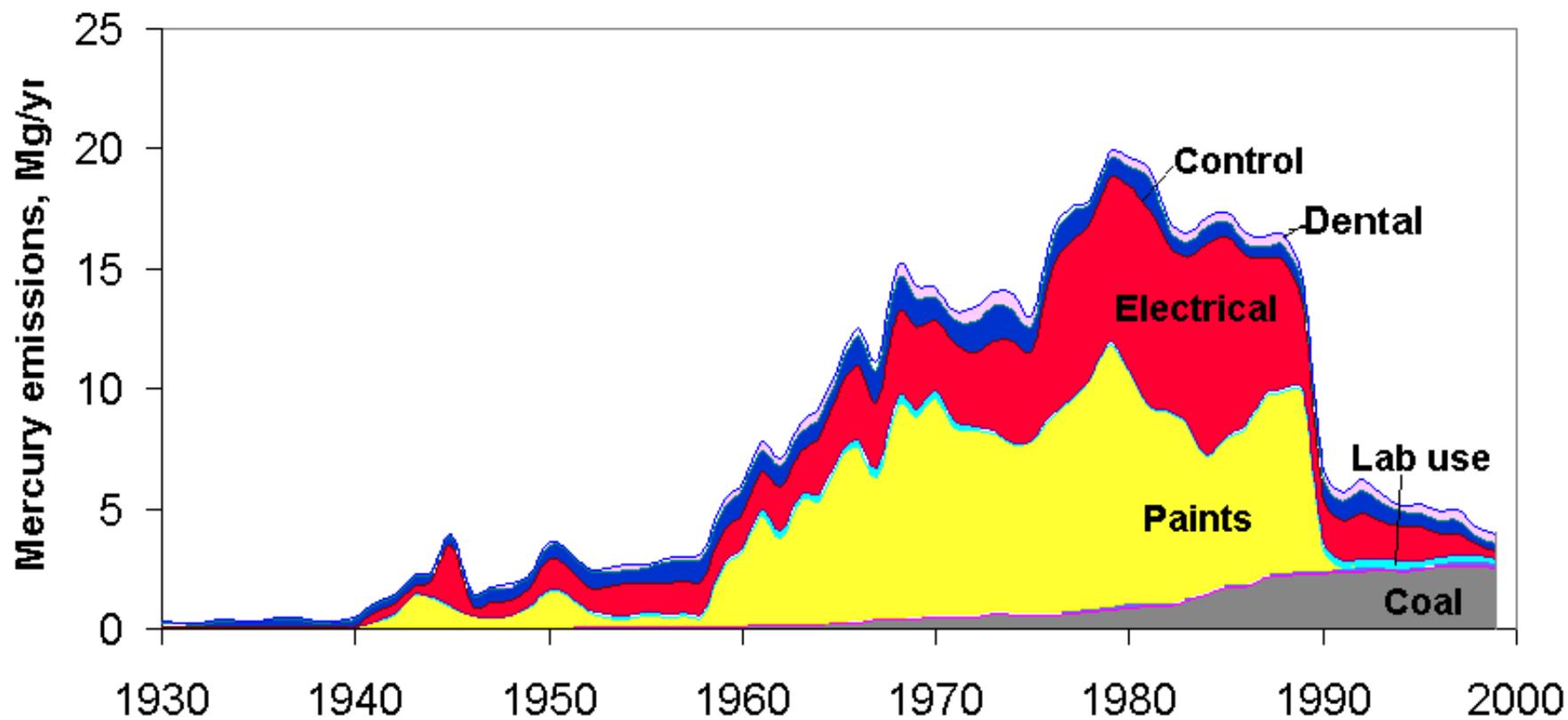
Everglades:

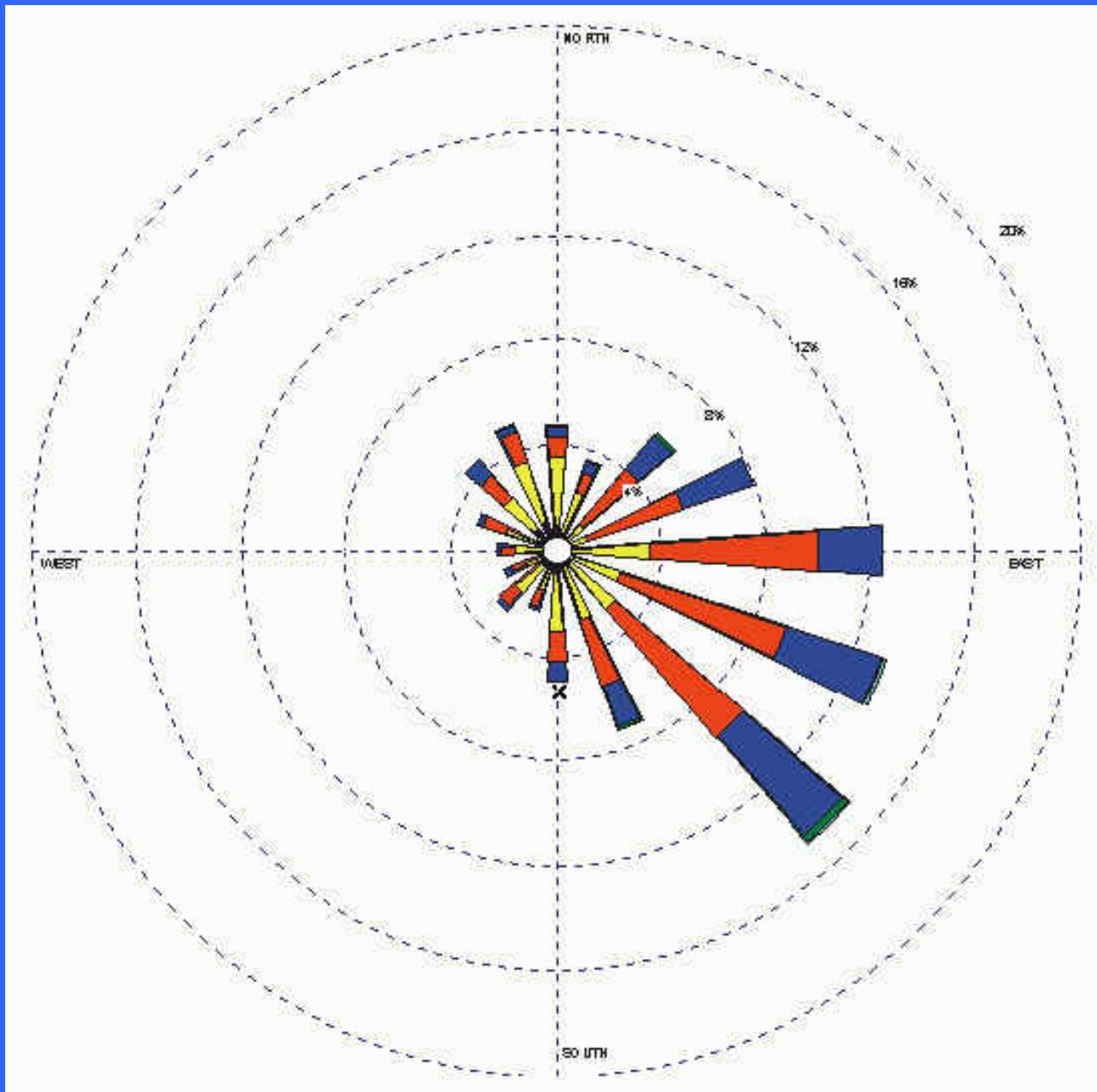
- Hot year-round
- High Photon Flux
- Shallow
- Close apposition of water surface & sediments
- High Surface to vol. Ratio
- High % wetlands
- High surface roughness





Trend of anthropogenic Hg emissions in Florida





Wind Rose: Miami, Fla., Summer 6 mos., 1992



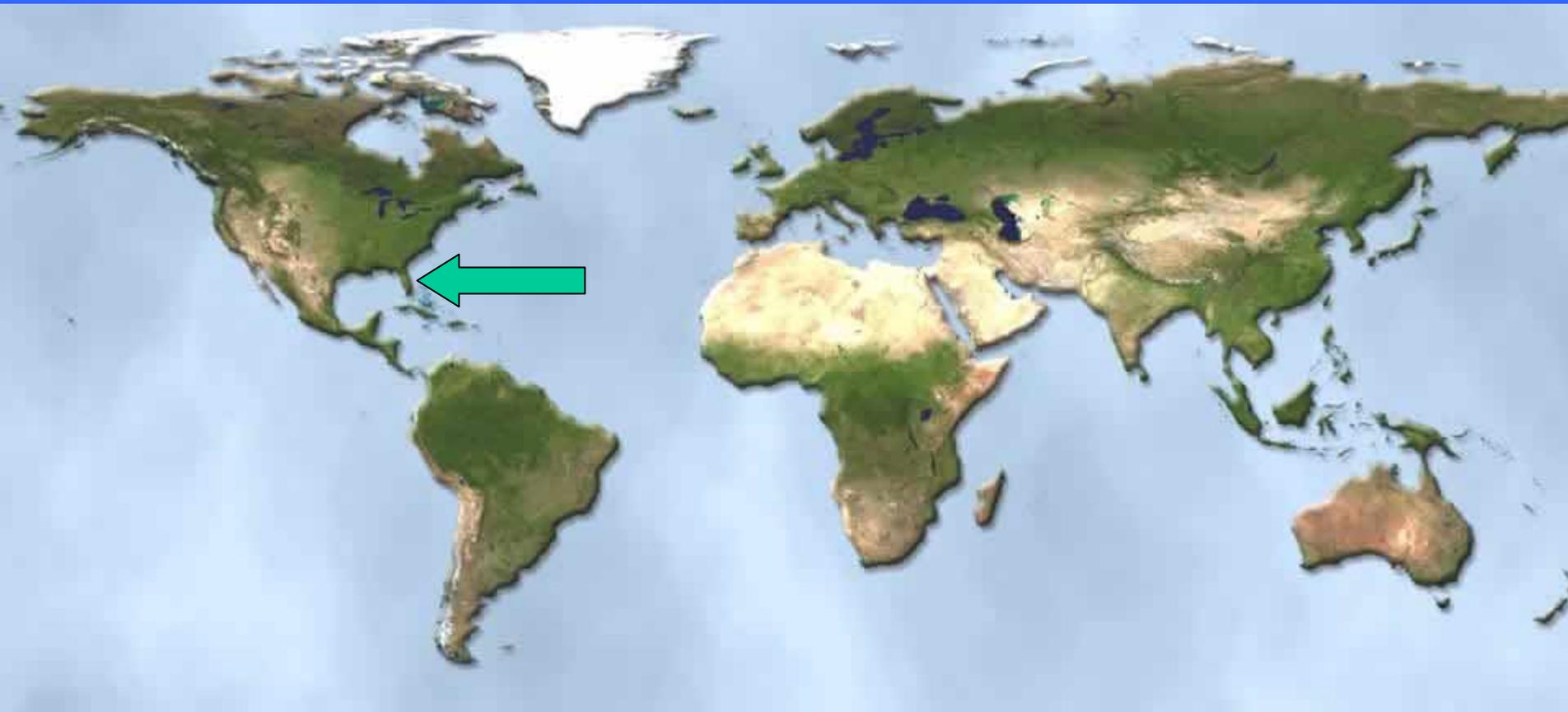
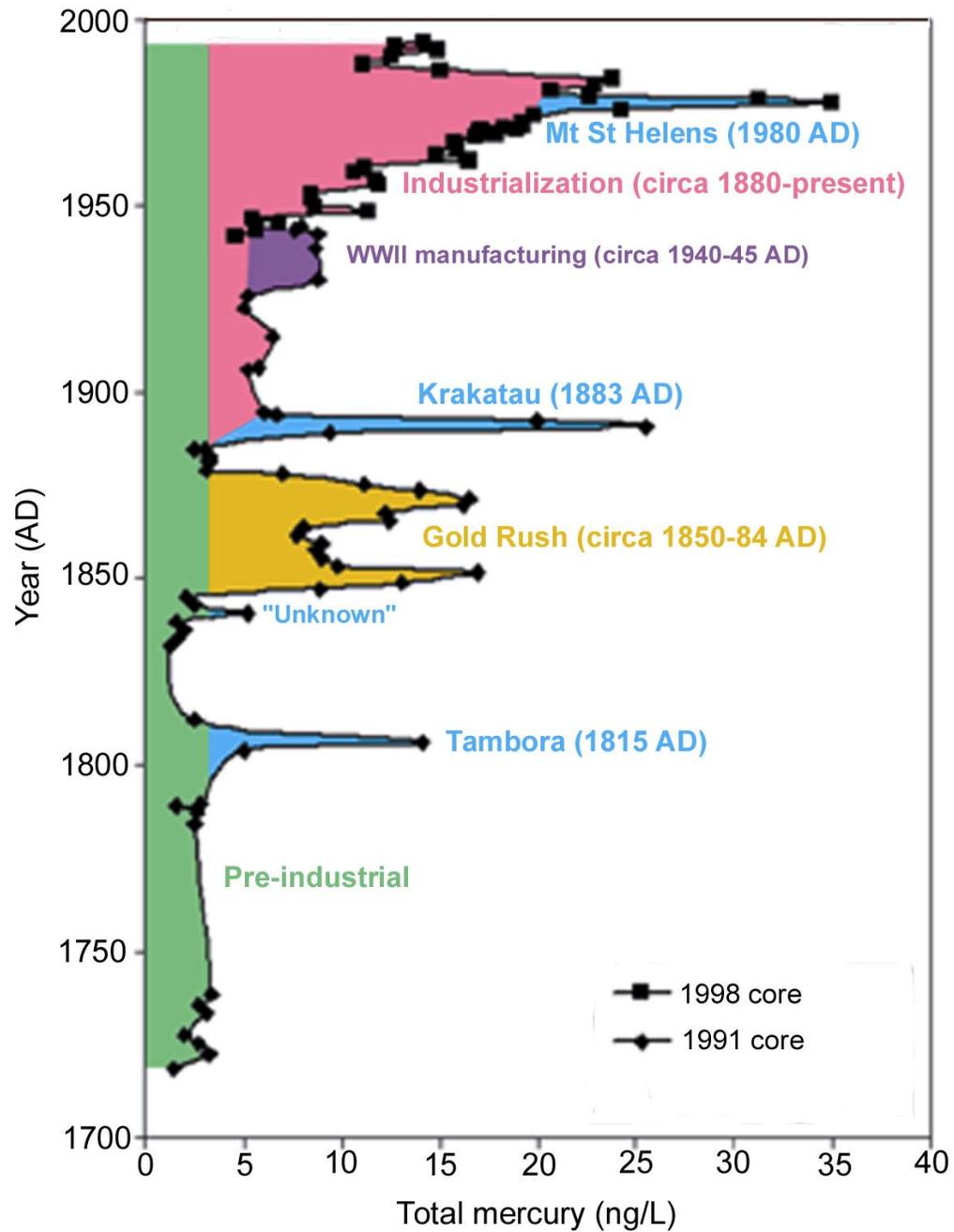


Figure 2



Science has a face, a house, and a price;
it is important to ask who is doing science, in
what institutional context, and at what cost.

Understanding such things can give us
insight into why scientific tools are sharp for
certain types of problems and dull for others.

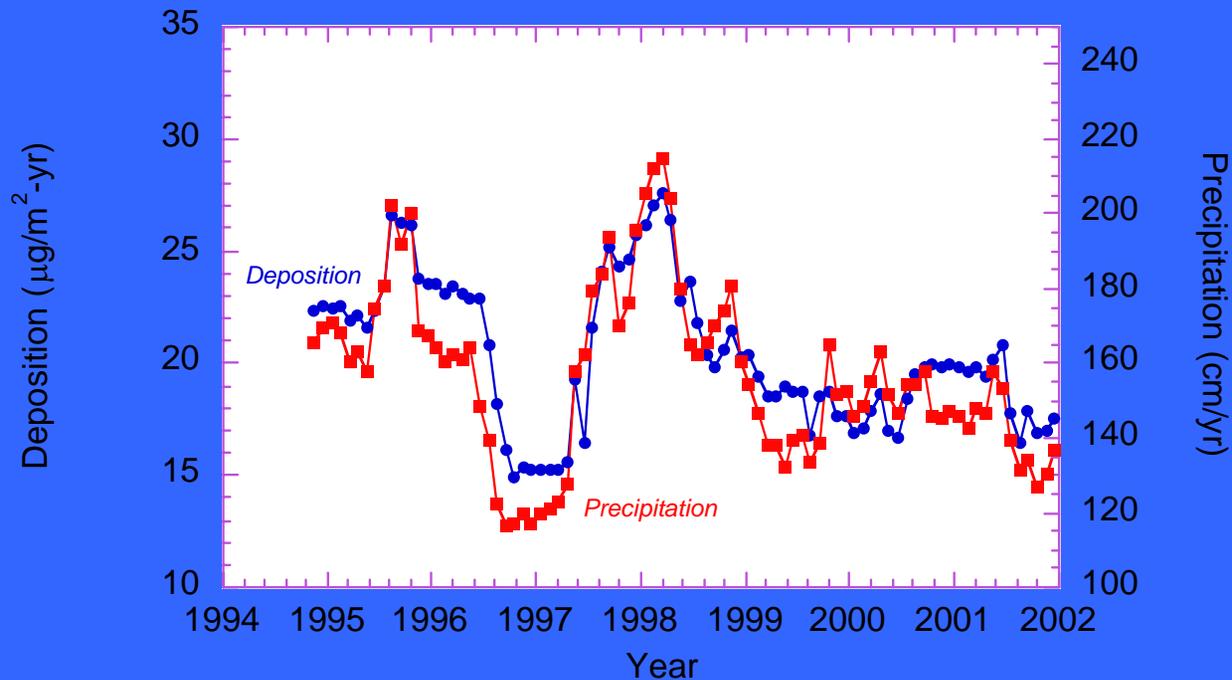
— Robert Proctor, *Cancer Wars*

Truth crushed to earth
shall rise again;
the eternal years of God are hers.

But error, wounded,
writhes with pain,
and dies among his worshipers.

— *Bryant*

Annual Hg Wet Deposition and Precipitation Fluxes at Everglades National Park, 1994 - 2002. Data from Guentzel et al. (2002) and MDN. Data expressed as 12 month running total.



Medical Waste Incinerators

Varying sizes

