Mercury cycling in urban settings

The impacts of local mercury deposition on soils and stream sediments in central Indiana

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Background

- Mercury cycle has global and local components
- In the coal-powered Midwest, local depositional sources of mercury to landscapes important to monitor
- Air sampling provides deposition data, but not necessarily transport data critical to understanding post-depositional processes
- Case Study central Indiana

Source	Emissions (Mg/year)	Percent of Total
Electric utilities	41.5	27.3
Waste incineration	28.8	19.0
Commercial and residential coal burning	12.8	8.4
Mining	6.4	4.2
Chloro-alkali Facilities	6.7	4.4
Mobile sources	24.8	16.3
Other sources	30.9	20.3
Total	151.9	100

Central Indiana emission sources

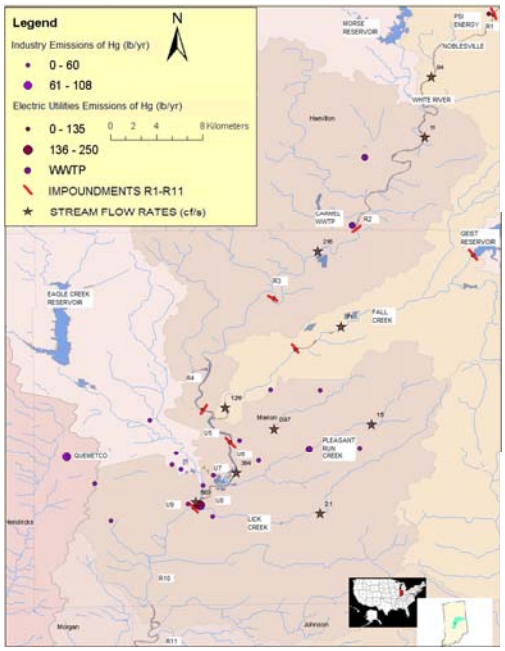
Facility Name	Pounds/Year	Location
IPALCO-Pritchard Station	225.2	
IPALCO-South Station	224.7	
PSI Energy-Noblesville	133.3	Noblesville
Quemetco, Inc.	98.0	
Daimler Chrysler Corporation Foundry	48.5	

Objectives

- To monitor transport of mercury along an impounded and urbanized river system
  - Impoundments may enhance methylation processes
  - Mercury content of sediments one component of methylmercury fluxes
  - Many urban anglers
- To characterize net depositional patterns from a geospatial perspective using soil samples
  - Inexpensive, easy to collect and measure
  - May provide landscape-based data on mercury transport to riparian zones

White River Watershed

- Hydrology
- Impoundments
- Emissions

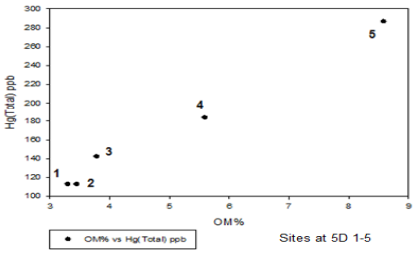


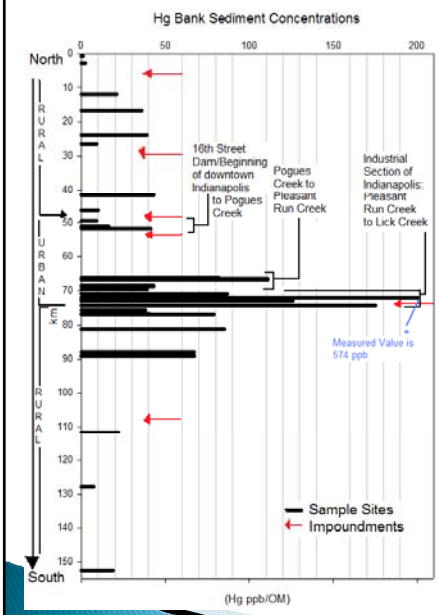
Bank sediment mercury

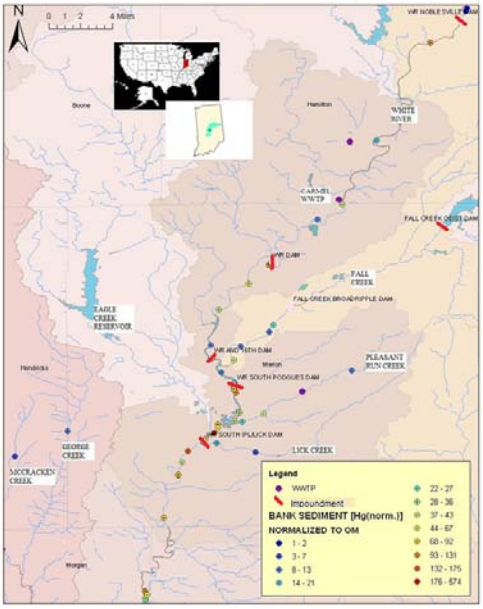
- Total Mercury concentrations vary between 6 ppb and 830 ppb
- % OM varies between 1.7 and 14.2

- Utilized normalization approach to constrain excess Hg
  - Dilution by terrigenous matter may obscure mercury source patterns
  - Normalization to organic matter

Impoundment			
Stretch	[Hg Total]	[Hg]	
Site	ppb	Normalized To OM	% OM
R1	6	2	4.4
R2	261	131	2.0
R3	158	29	6.6
R4	128	24	6.5
U5	99	27	8.3
U6	173	25	8
U7	301	66	5
U8	830	159	4
U9	322	39	14.2
R10	229	82	2.9
R11	226	62	3.8
R12	72	22	3.1
R13	13	7	1.7
R14	38	19	2.1

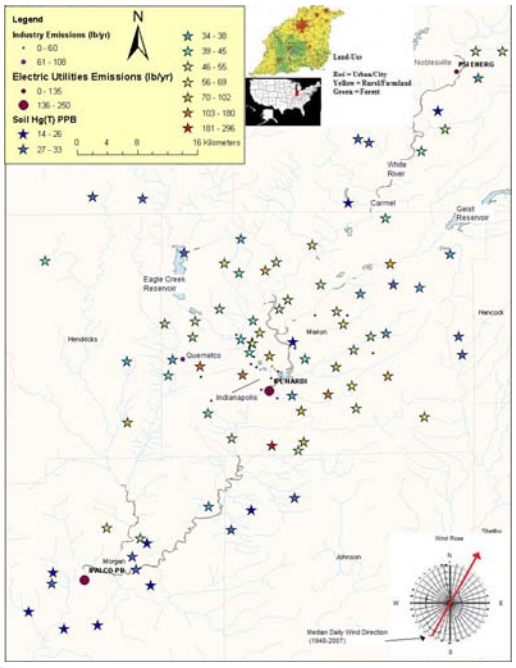






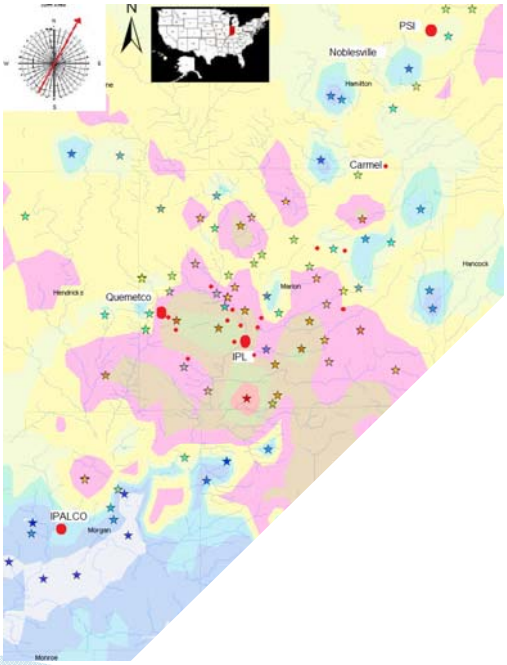
Soil Mercury concentrations

- Emission Sources
- Soil Mercury
- Wind Rose



Soil Mercury

- Kriged data model
- Indicates urban concentration



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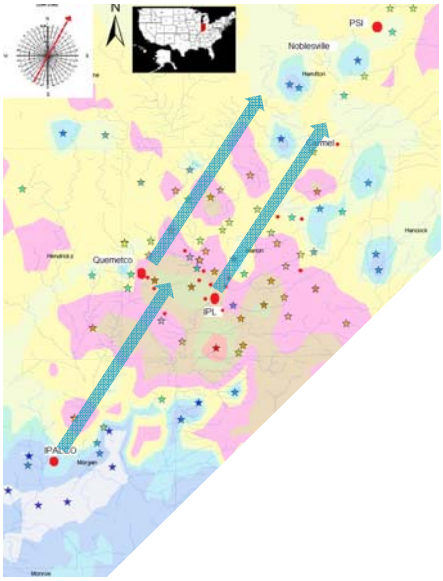

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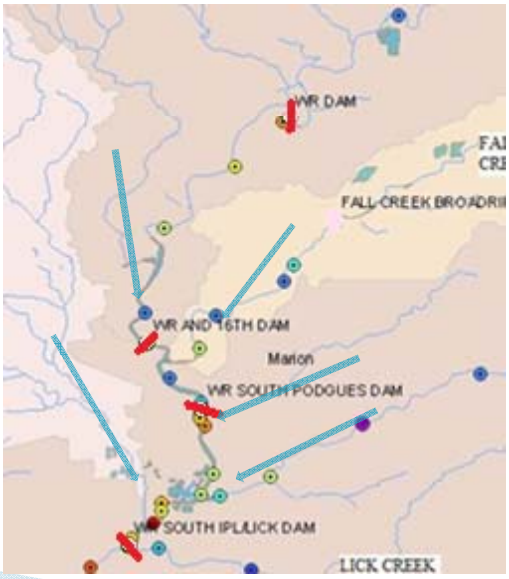

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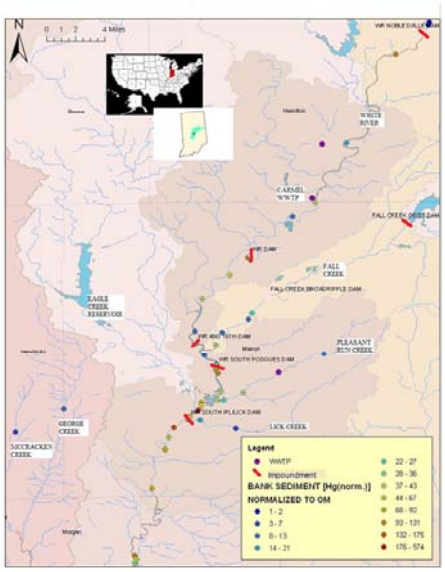

Conclusions

- Emission sources seem to have local depositional impact
- Atmospheric and hydrologic processes critical for risk analysis
  - Net northeastward atmospheric deposition pattern
  - Net southwestward riverine transport of mercury
- Urban sources persist well into rural localities via riverine transport
- Implications for anglers, their families collecting fish from “pristine” rural river stretches

Soil and Sediment Ratio	
Watershed Values	
SOIL/SED.	Soil Hg(T)/Sed Hg(T)
A	0.34
B	0.22
C	Drains into
D	0.22
F	0.14