Patterns and Trends of Total Mercury and Dissolved Organic Carbon in Urban Canals, Miami, FL (USA)

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Why Total Mercury and Dissolved Organic Carbon?

 Methylmercury (MeHg), a dangerous toxin, readily bioaccumulates in aquatic food webs. The production of MeHg is often found where high concentrations of particulate total mercury (PTHg) and dissolved organic carbon (DOC) occur, such as wetlands.

> "Favorable conditions for the conversion of Hg(II)i to MeHg include lower dissolved oxygen concentration, higher concentrations of dissolved organic carbon (DOC) and sulfate, and higher temperatures."

- (Booth et al., 2020)

Research Questions

1. How are DOC and PTHg related in coastal urban aquatic ecosystems? 2. How are DOC concentrations related to spatial variation in urban infrastructure? 3. How are PTHg concentrations related to spatial variation in urban infrastructure?

Study Locations

- Miami Dade County urban canals (n = 17)
- Range in covariates of urban infrastructure:
 - Distance to Coast
 - Percent Impervious Groundcover
 - Stormwater Outfall Density
 - Septic Tank Density



Sampling Methods



• PTHg:

- Unfiltered water samples were collected into light sensitive containers.
- DOC:
 - 0.22 um Millipore filtered water samples were collected.



Analysis Methods



• PTHg:

- Tekran Millennium Merlin Mercury Analyzer.
- Duplicates of each collected sample were ran.
- DOC:
 - Shimadzu TOC-V Total
 Organic Carbon
 Analyzer.
- R Studio was used to run linear models and multiple linear regressions.



1. How are DOC and PTHg related in coastal urban aquatic ecosystems?



PTHg and DOC were not correlated and covaried with different components of urban infrastructure.

2. How are DOC concentrations related to spatial variation in urban infrastructure?

DOC								
	Estimate	Std. Error	T- Value	P - Value				
(Intercept)	-0.4516	0.7422	-0.608	0.5543				
Avg % Impervious	0.03336	0.01865	1.789	0.0989				
SW Outfall Count	0.001946	0.0007655	2.542	0.0259	*			
Septic Tank Count	0.0001888	0.0000836	2.258	0.0434	*			
Coast	0.2512	0.0347	7.24	0.0000103	*			

- DOC was positively related to distance to coast, stormwater outfall density, and septic tank density.
- The highest DOC concentrations were seen around the Everglades, (furthest from the coast).

3. How are PTHg concentrations related to spatial variation in urban infrastructure?

Mercury								
	Estimate	Std. Error	T- Value	P - Value				
(Intercept)	2.0683792	1.5887131	1.302	0.20319				
Avg % Impervious	0.1624683	0.0399215	4.07	0.000331	*			
SW Outfall Count	0.0020528	0.0016386	1.253	0.220296				
Septic Tank Count	-0.0007565	0.000179	-4.227	0.000215	*			
Coast	-0.1499393	0.0742642	-2.019	0.052817				

- PTHg was positively related to imperviousness and septic density, suggesting surface as well as groundwater sources of contamination.
- The highest PTHg concentrations were seen around the Miami International Airport (MIA).

What is the data showing us?



- There is not as much correlation between DOC and PTHg as previously expected.
- DOC and PTHg interact with urban infrastructure in different ways.
- The Everglades acts as a source DOC meanwhile MIA acts as a source of PTHg.



Future Work

- Global increases in methane emissions are likely having impacts on mercury (especially MeHg) and should be further studied.
- The interactions and responses of DOC and PTHg to different environmental conditions remains uncertain.
- Further investaging levels of Methymercury present in Miami Dade County urban canals.
- The effects of urban development on the health of Miami Dade urban canals should be looked into.



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