

Assessing the Effects of Urban Land Use on Stream Ecosystems: Integrating Analytical Chemistry, Toxicity Test, and CYP1A1 Gene Activation Data from Extracts of Semipermeable Membrane Devices



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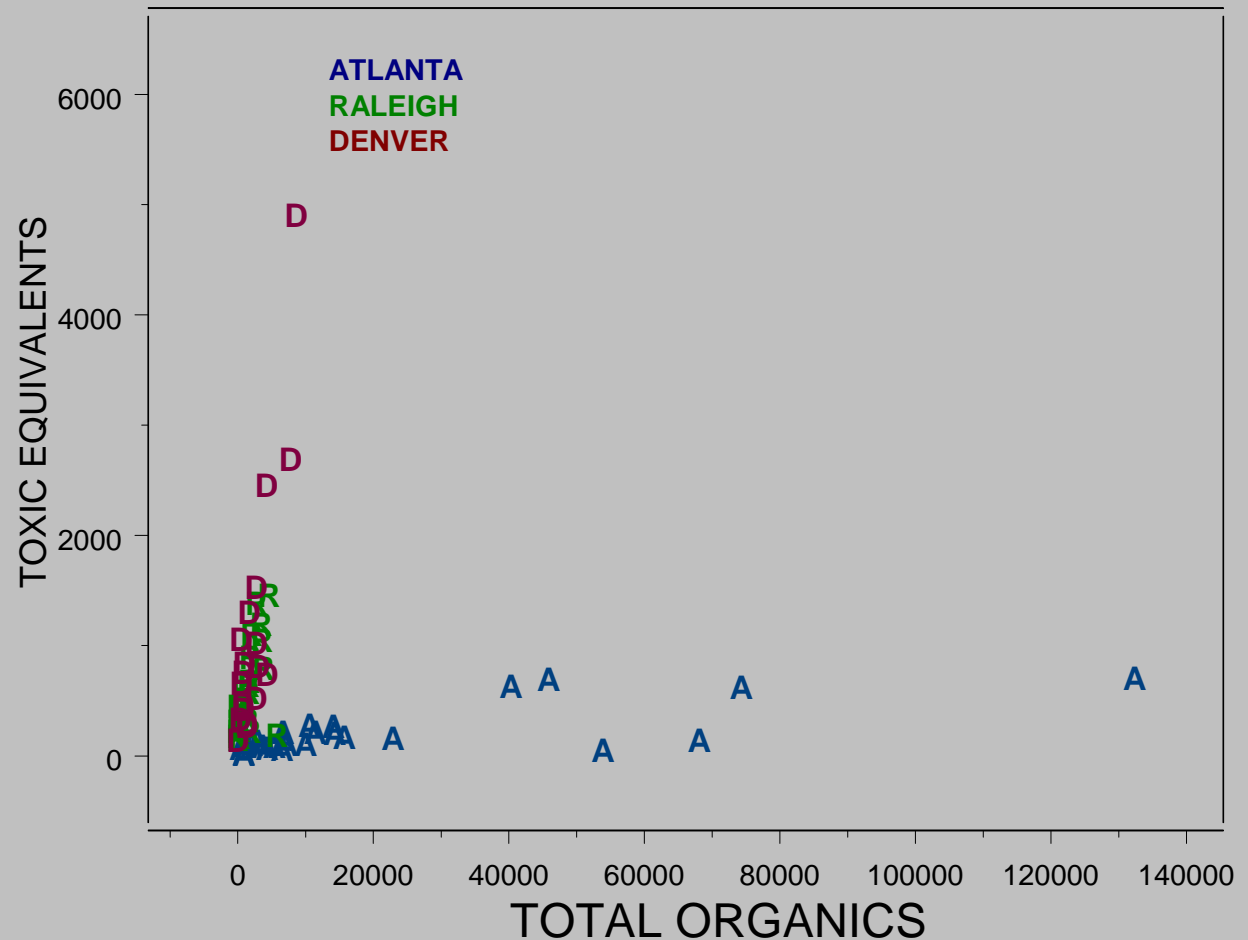
Overview

Design

SPMDs

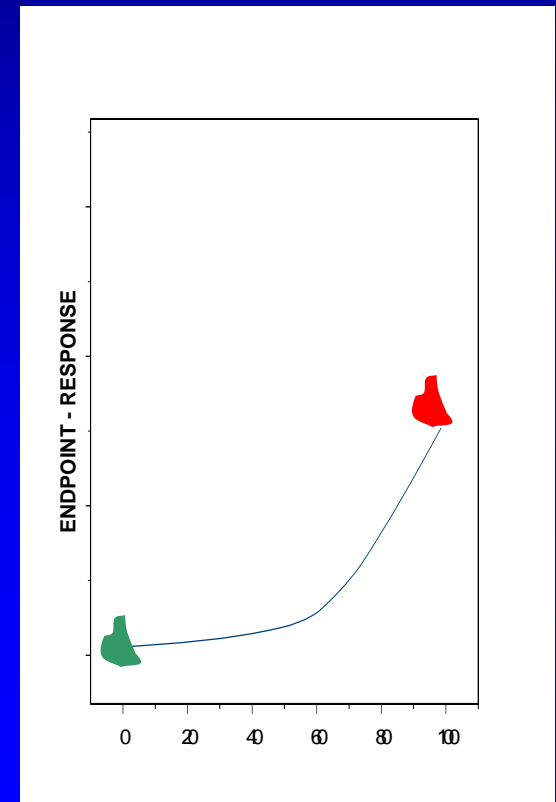
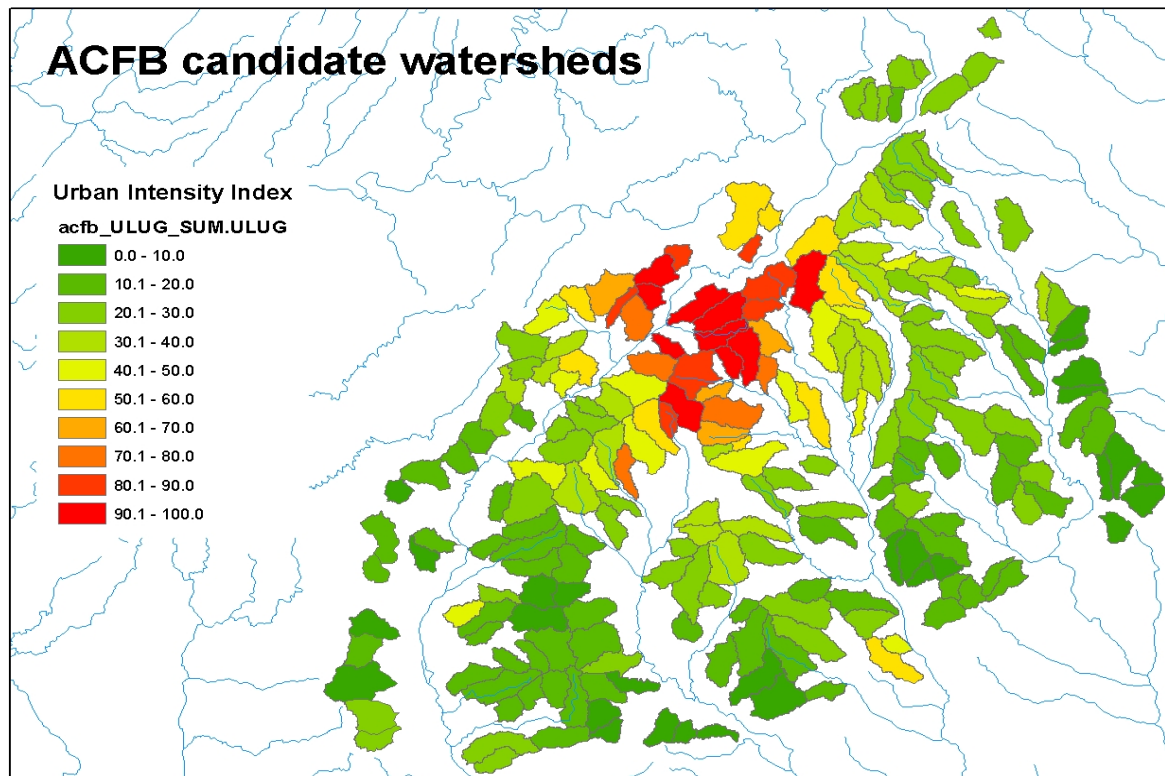
Endpoints

Results



Design

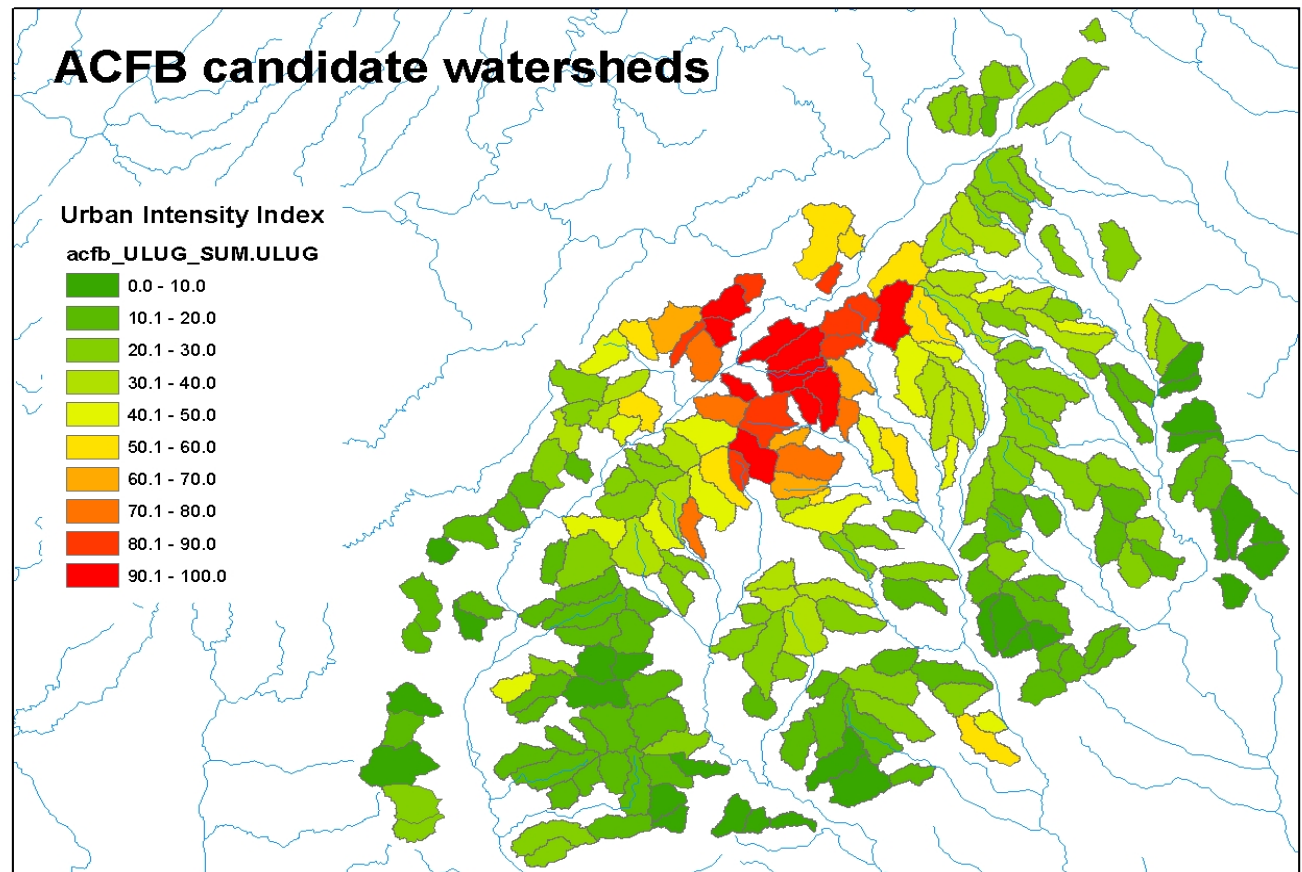
- Range of urban intensity
- Minimize confounding factors
- Chemical, Physical, Biological Endpoints



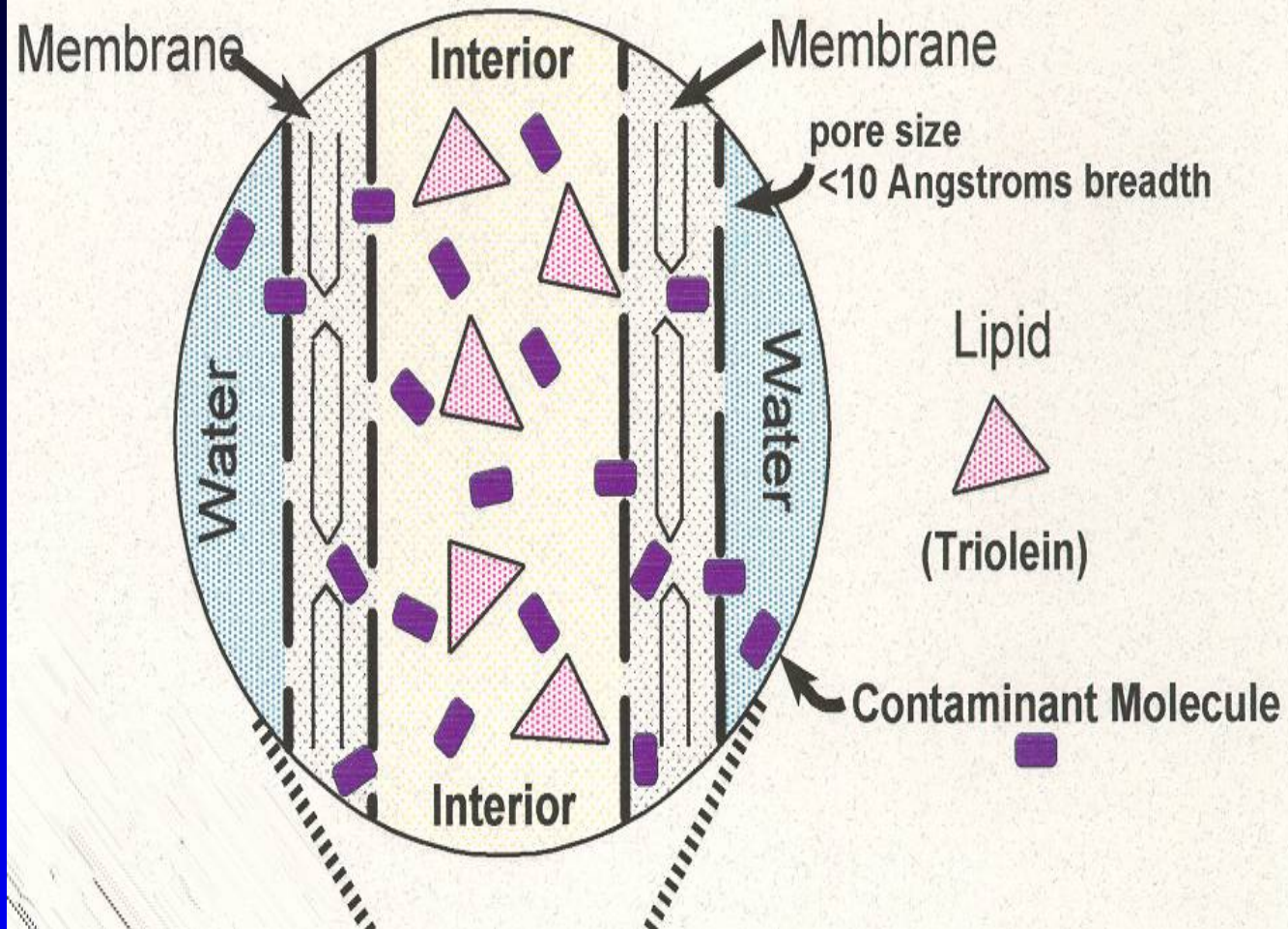
Design

- Repeat in different environmental settings

Boston
Birmingham
Salt Lake City
Atlanta
Raleigh
Denver
Milwaukee
Dallas
Portland
Sacramento
Seattle



Semi-Permeable Membrane Device



Cost effective and simple

Lipophilics ($K_{ow} > 3$)

Integrate over time

Stationary

Passive

Ametabolic

Analytical Chemistry

Bioassays & Toxicity test

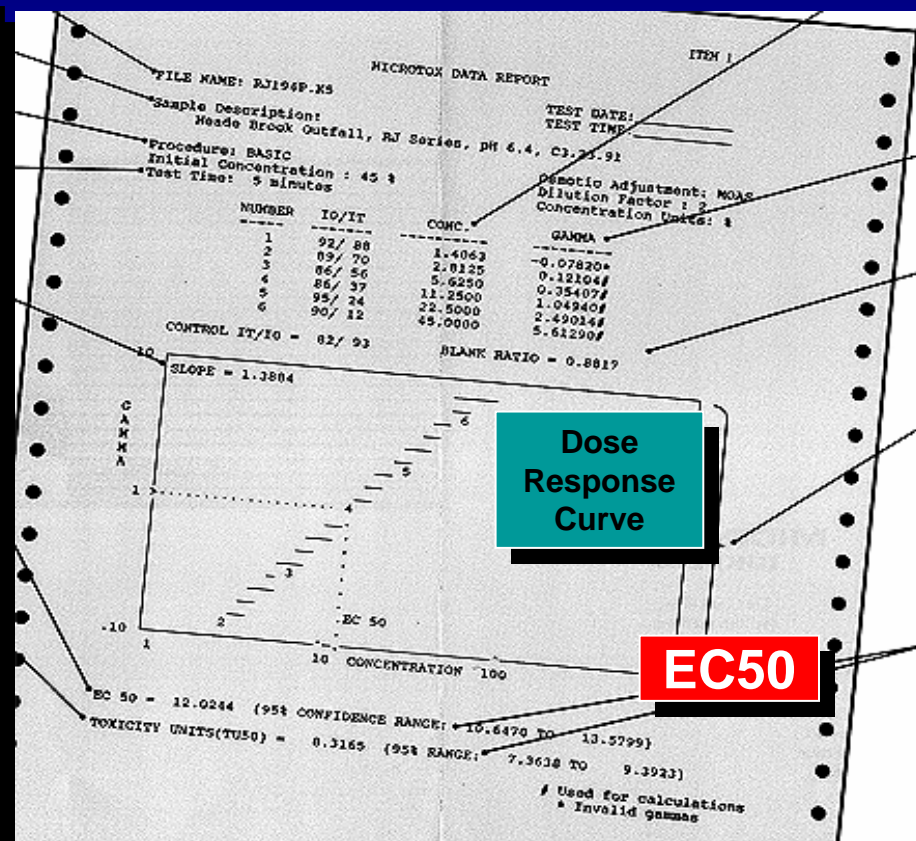


Endpoints

Microtox^R

Toxicity

EC50



Endpoints

Fluoroscan

“Total” PAHs

Pyrene equivalents



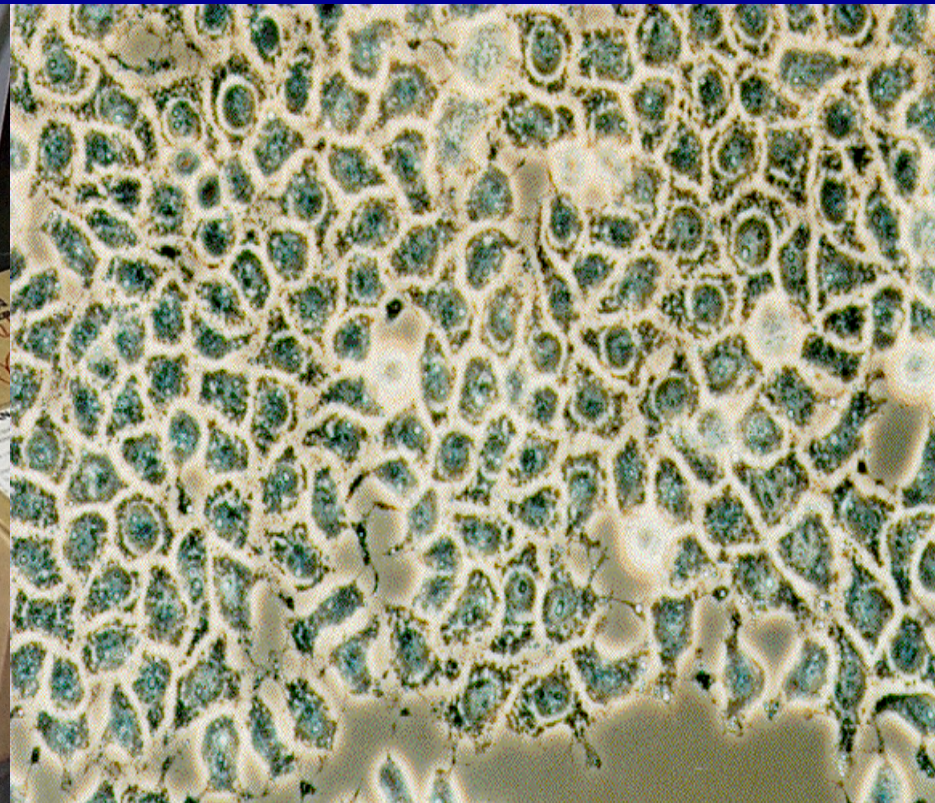
Endpoints

CYP1A1

Cellular enzyme induction

pgTEQ/SPMD

Dioxins, Furans, PCBs, PAHs



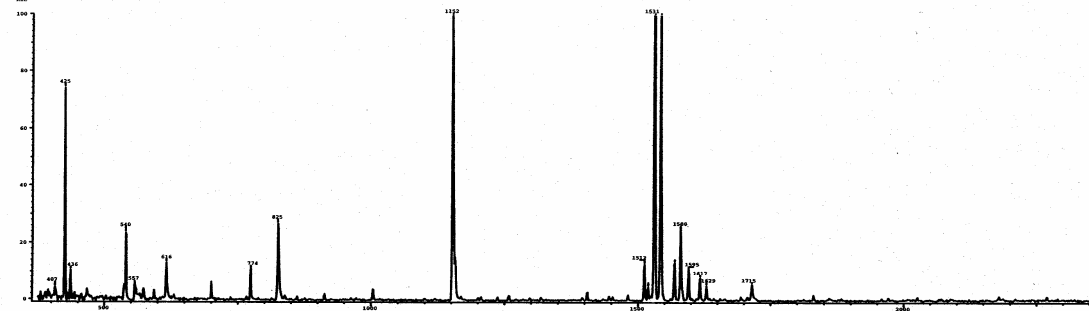
Endpoints

Analytical Chemistry

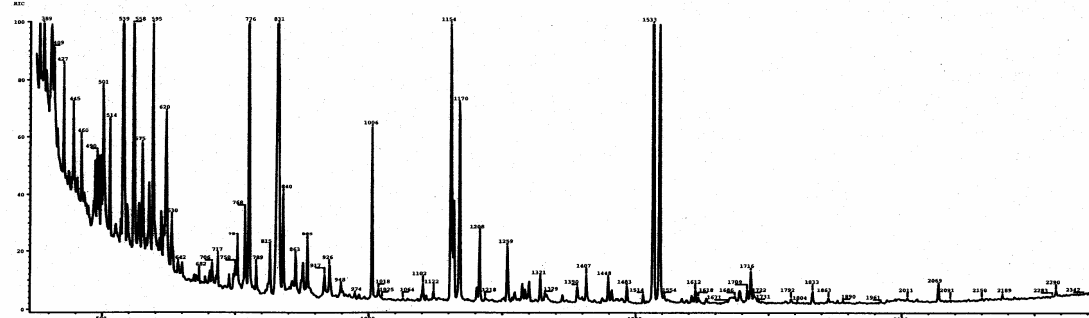
Concentration of knowns - standards
Identified some unknown peaks



CHROM: july1413.D.ms 13J-Jul-00 09:11:54
Data: 13J-Jul-00 09:11:54
Comp: Precision 2 standard from Low Volume and Overline Bay
Mod: 62 VFA 14mm NUCAL (200) 10 40 mm
Wash: 100% MeOH
Peak: 1000.0 mm
Area: 2. 0. 0
RSC: 1.001267
RSC



CHROM: july1413.D.ms 13J-Jul-00 10:11:37
Data: 13J-Jul-00 10:11:37
Comp: Precision 2 standard from Low Volume and Overline Bay
Mod: 62 VFA 14mm NUCAL (200) 10 40 mm
Wash: 100% MeOH
Peak: 1000.0 mm
Area: 2. 0. 0
RSC: 1.001267
RSC



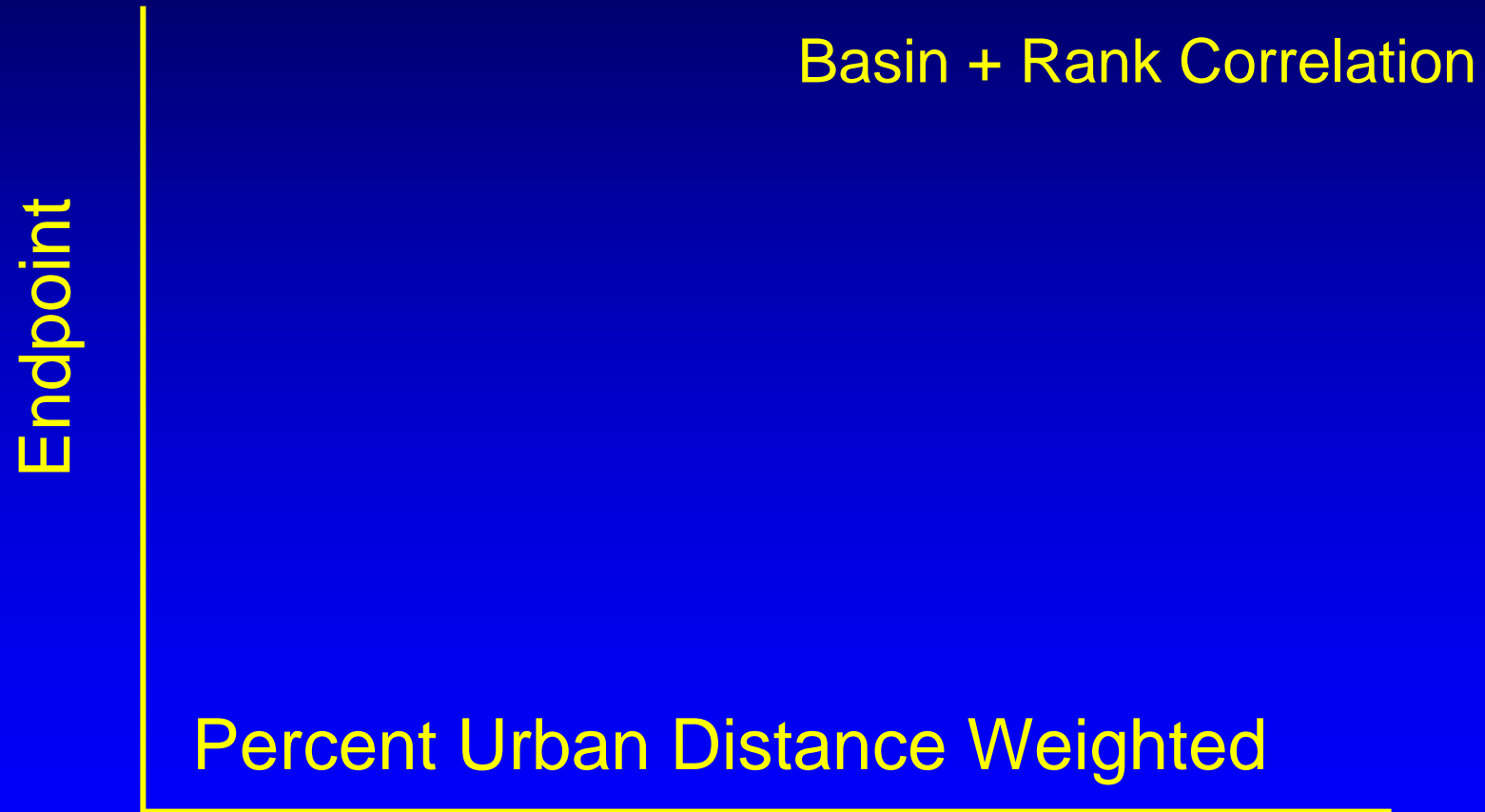
Are there differences in Microtox[®], Fluoroscan and CYP1A1 along a gradient of urban intensity?

Do results support analytical chemistry?

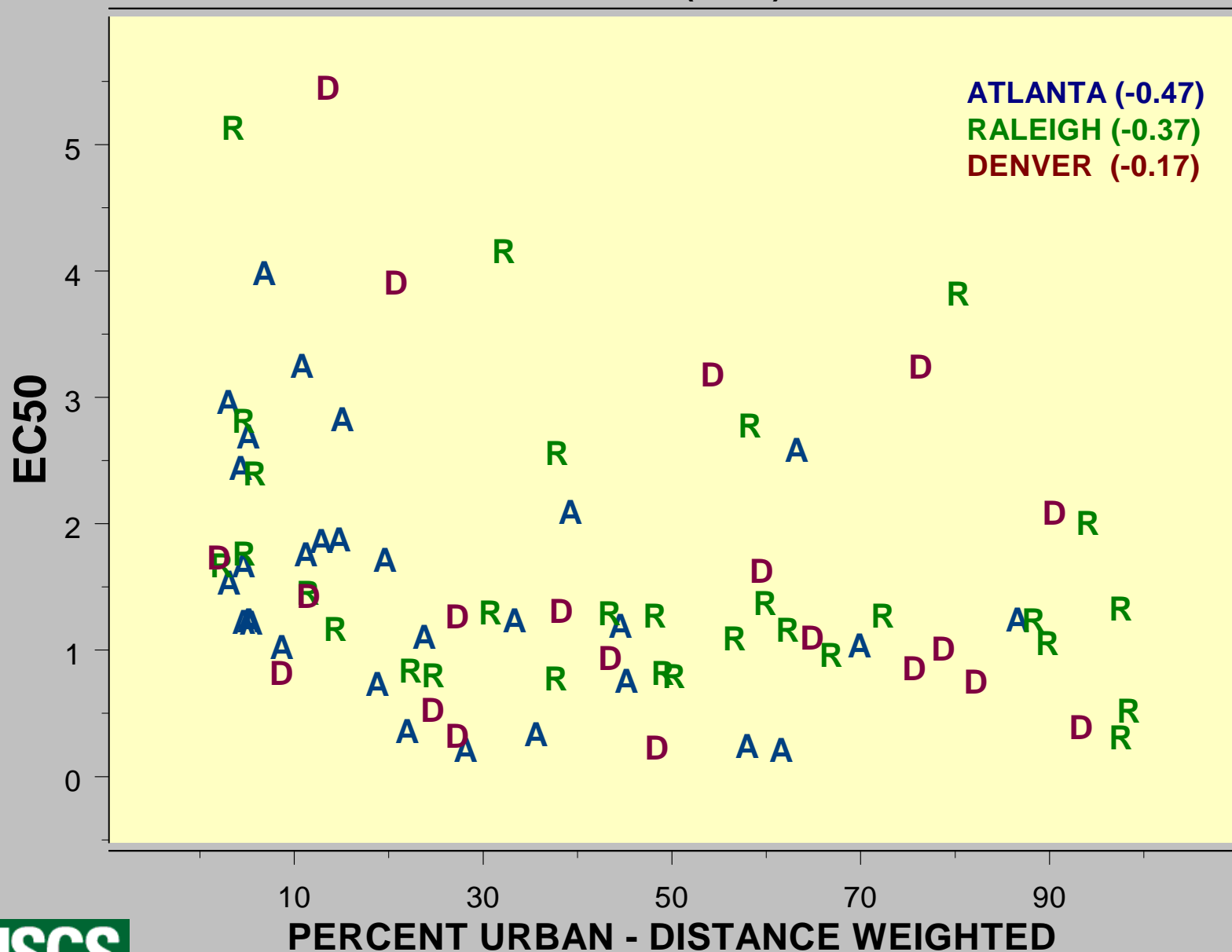
How do results compare across environmental settings?



Results



Microtox (-0.33)

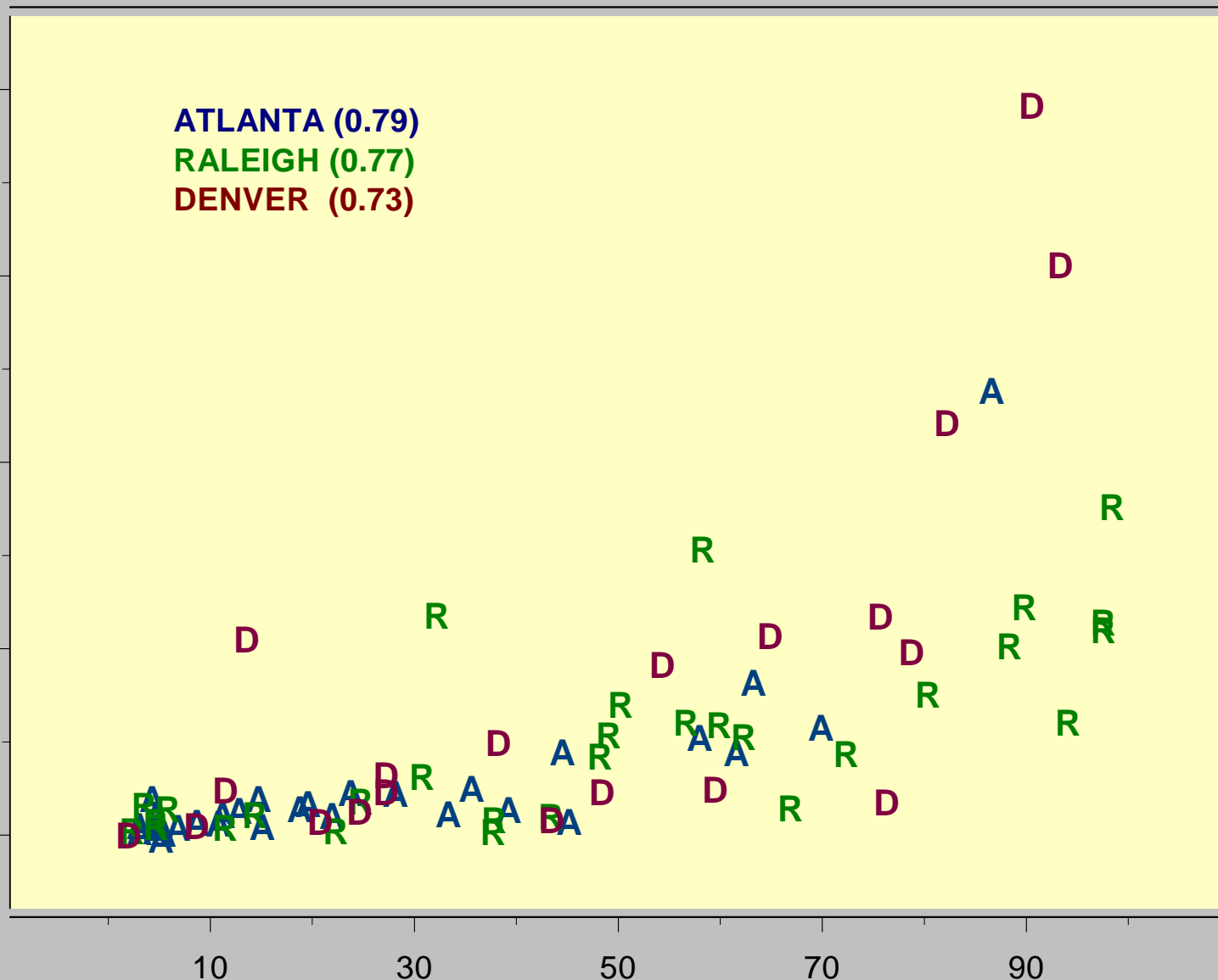


FLUOROSCAN (0.80)

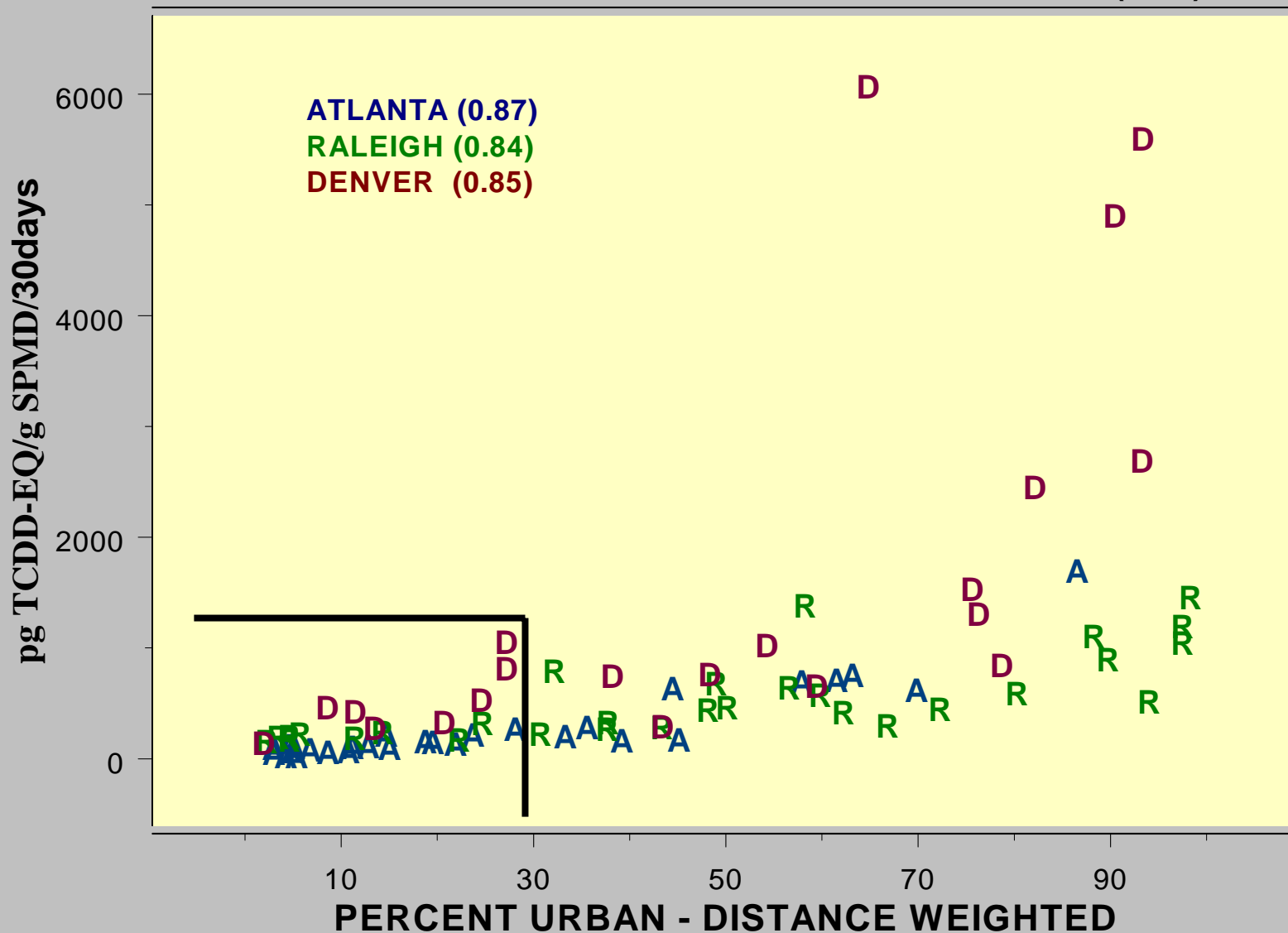
ugPyreneEQ/g/30days

ATLANTA (0.79)
RALEIGH (0.77)
DENVER (0.73)

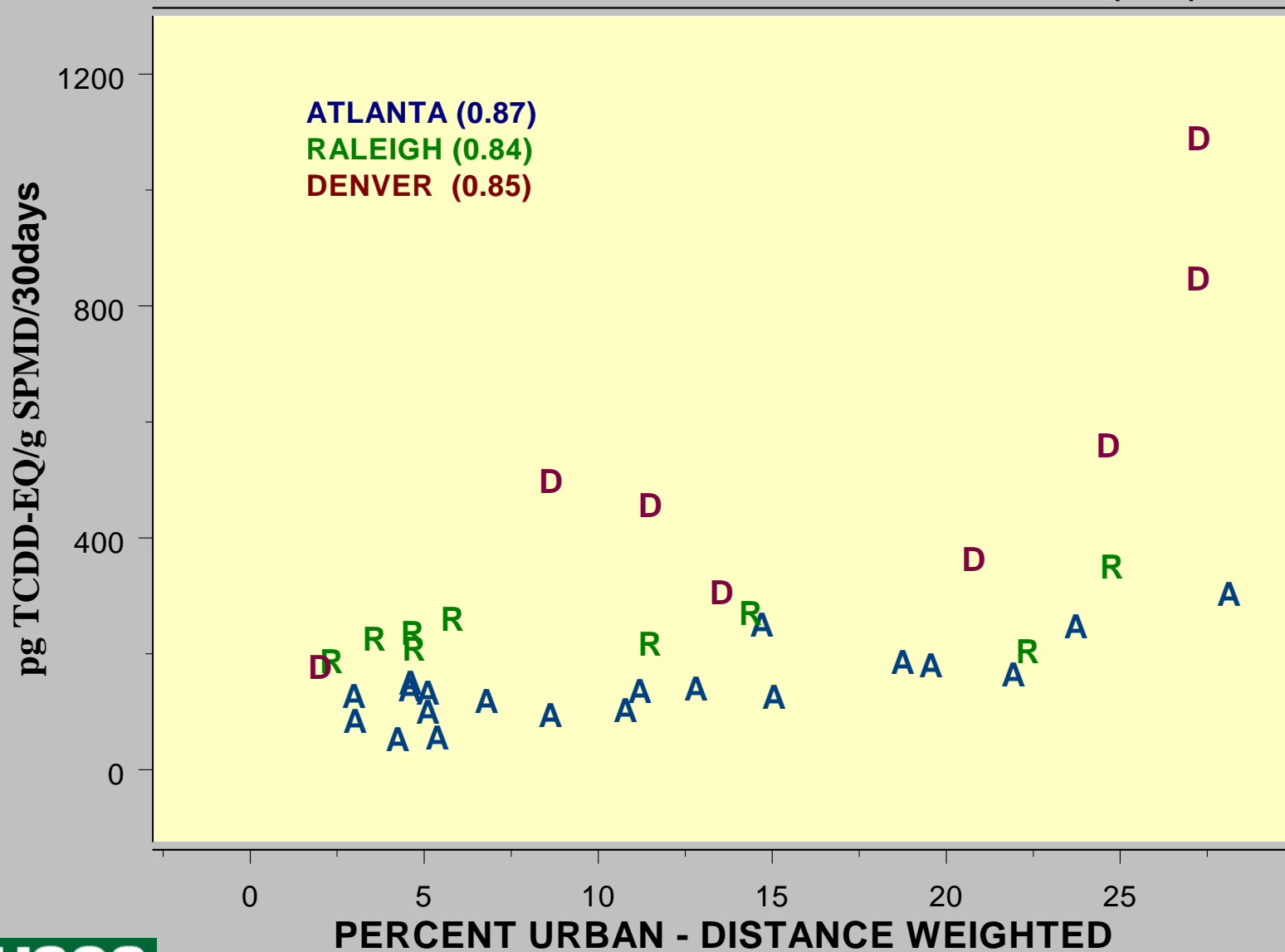
PERCENT URBAN - DISTANCE WEIGHTED



CYP1A1 VS PERCENT URBAN DISTANCE WEIGHTED (0.84)



CYP1A1 VS PERCENT URBAN DISTANCE WEIGHTED (0.84)



ANALYTICAL CHEMISTRY RESULTS

135 compounds detected

Minimum of 3

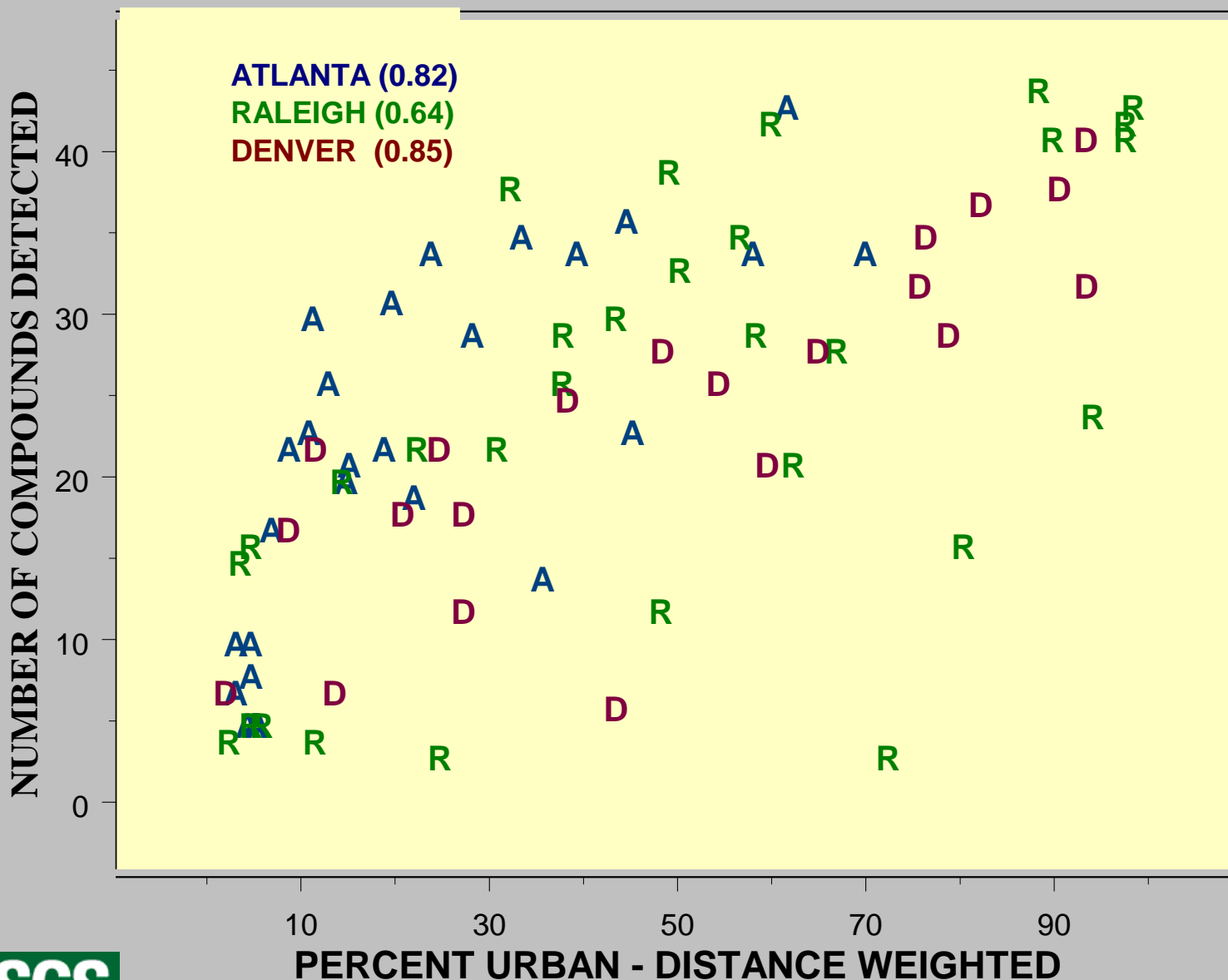
Maximum 45



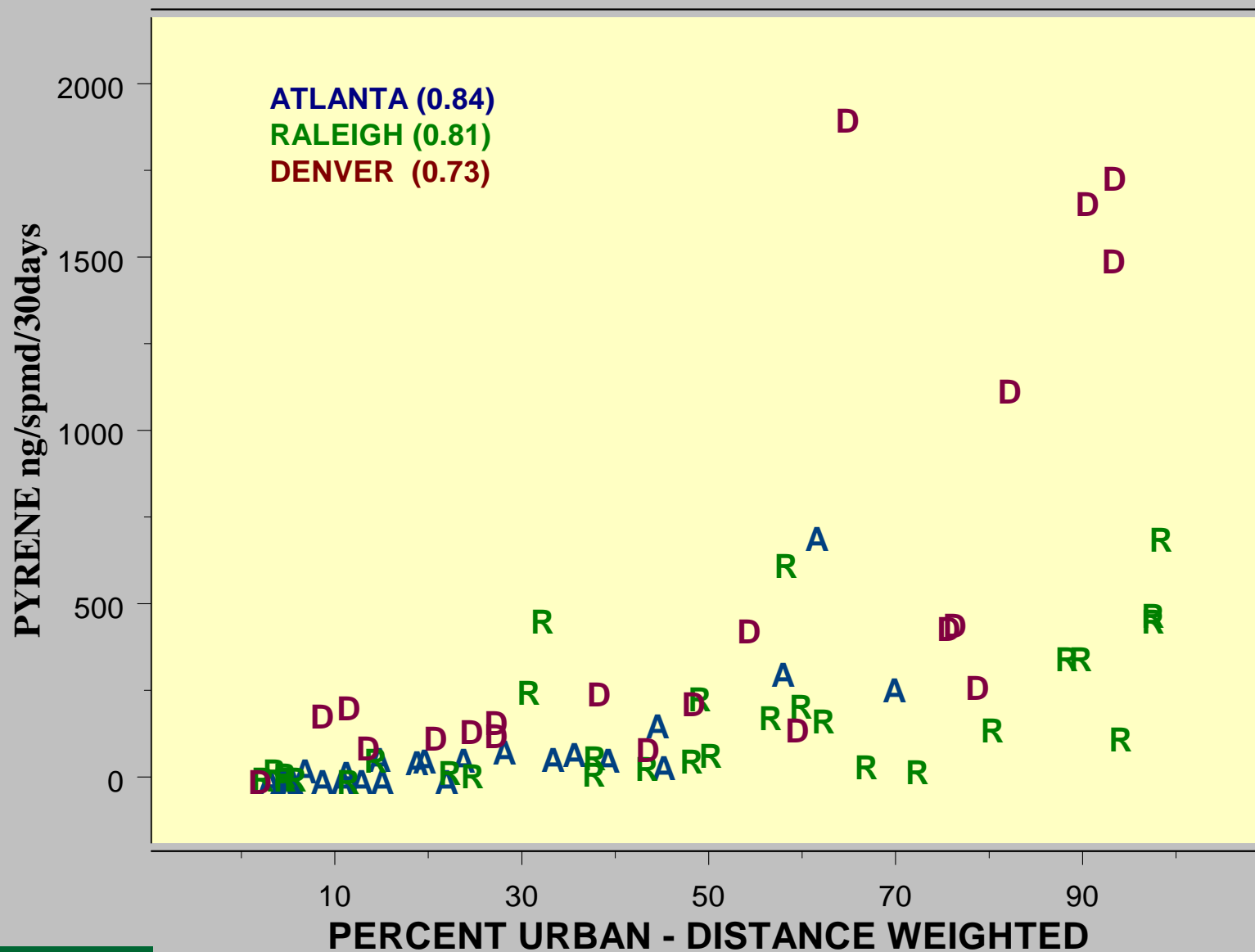
43 compounds detected > 10% of samples

22 compounds correlated with urban land use

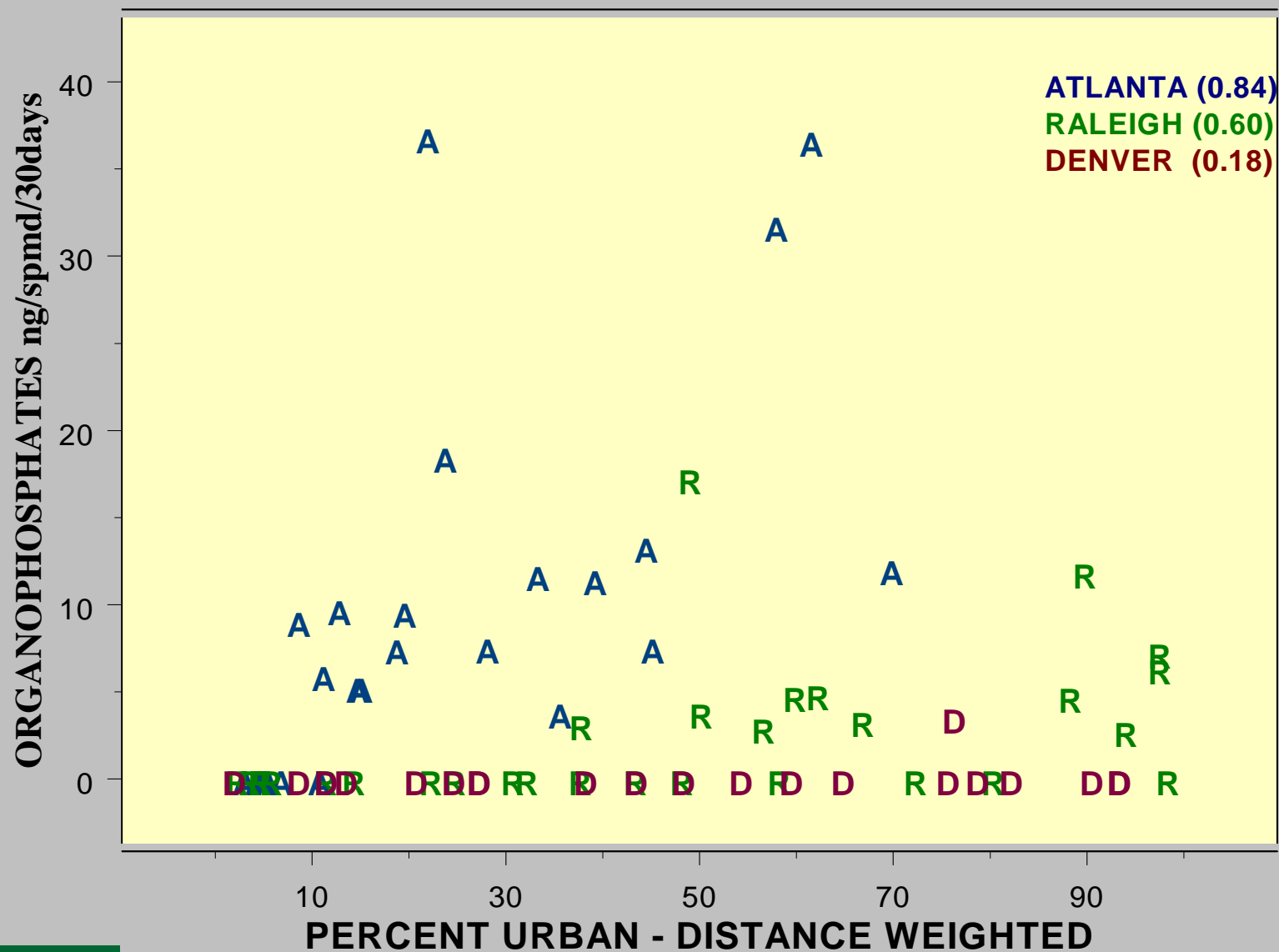
NUMBER OF DETECTS VS PERCENT URBAN DISTANCE WEIGHTED (0.70)



PYRENE VS PERCENT URBAN DISTANCE WEIGHTED (0.80)



ORGANOPHOSPHATES VS PERCENT URBAN DISTANCE WEIGHTED (0.24)



Are there differences in Microtox^r, Fluoroscan and CYP1A1 along a gradient of urban intensity?

Do results support analytical chemistry?

		Atlanta	Denver	Raleigh
CYP1A1	$ \rho > 0.6$			
Fluoroscan				
Microtox				

Fluoranthene	PAH			
Pyrene	PAH			
Dibenzothiophene	PAH			
4H-cyclopenta[de]phenanthrene	PAH			
Benzo(b)naptho [2,1]thiophene	PAH			
Benzophenanthrene	PAH			
Number of compounds detected				

How do results compare across environmental settings?

9 endpoints in all 3 basins $|\rho| > 0.6$

22 endpoints in at least 1 basin

		Atlanta	Denver	Raleigh
Phenanthrene	PAH			
Fluorene	PAH			
1,2,3,4-tetramethyl naphthalene	PAH			
Methyl-Pyrene	PAH			
Methyl-Dibenzofuran	Furan			
Methyl-9-H-Fluorene	PAH			
Methyl-Anthracene	PAH			
Pentachloroanisol (PCA)	Wood preservative			
Total Furans	Furan			
Total Organochlorines	Organochlorines			
Trifluralin	Herbicide			

There were differences between three basins.

		Atlanta	Denver	Raleigh
Benfluralin	Herbicide			
Chlorpyrifos	Pesticide			
DCPA	Herbicide			
AHTN	Musk			
Benz [c] acridine	PAH			
Trimethyl naphthalene	PAH			
Chlordane	OC- Insecticide			
Total Substituted PAH	PAH-substituted			
Total N PAH	PAH-Nitrogen			
Total Herbicides	Herbicides			
Total Organophosphates	Organophosphates			

SO WHAT

SPMDs and micro-assays useful and cost effective

Management and Policy Implications:

Multiple stressors (physical, biological, chemical)

Complex mixtures

Management / mitigation strategies

Source, transport, toxicity



Thanks to the many that contributed

