

# 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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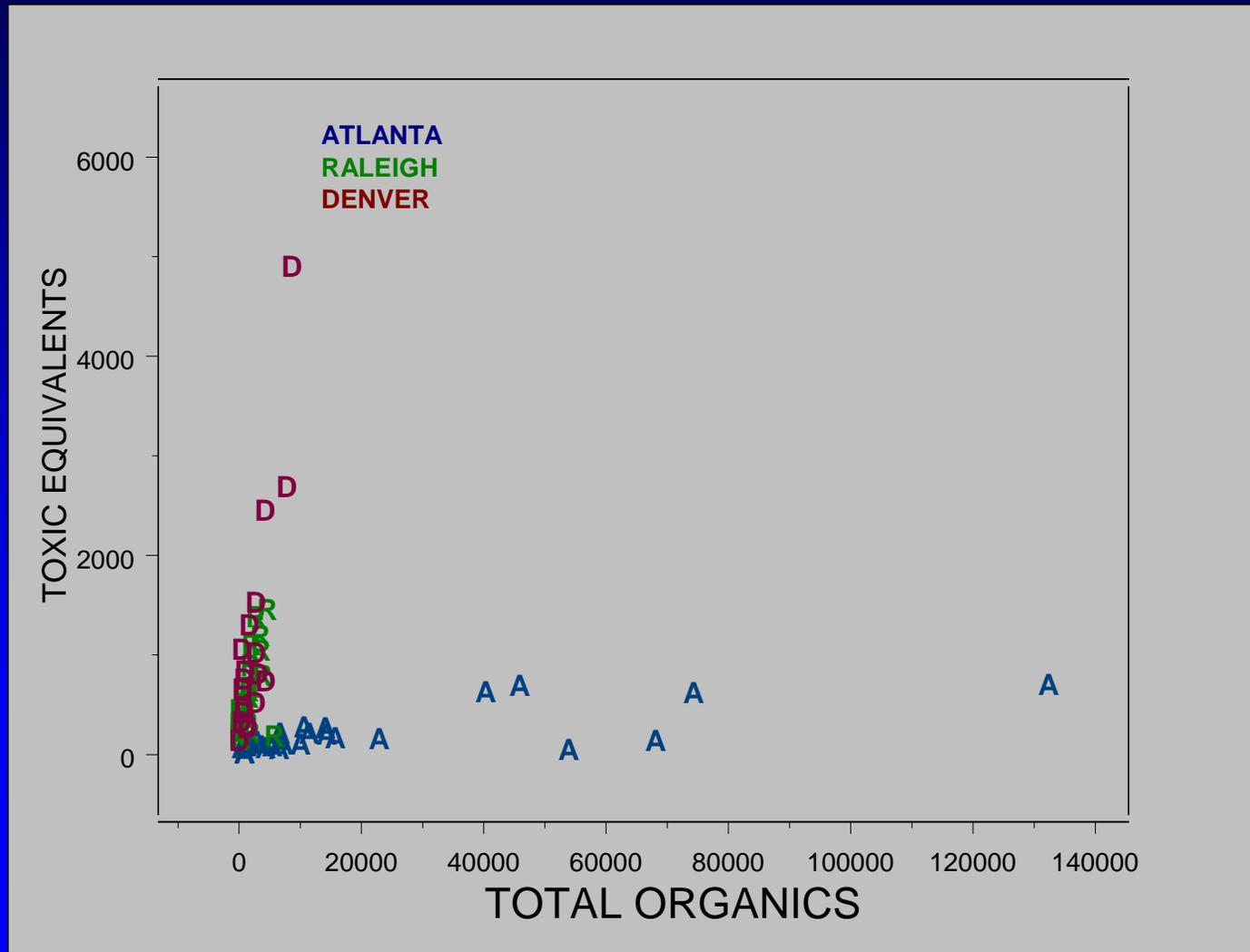
# Overview

Design

SPMDs

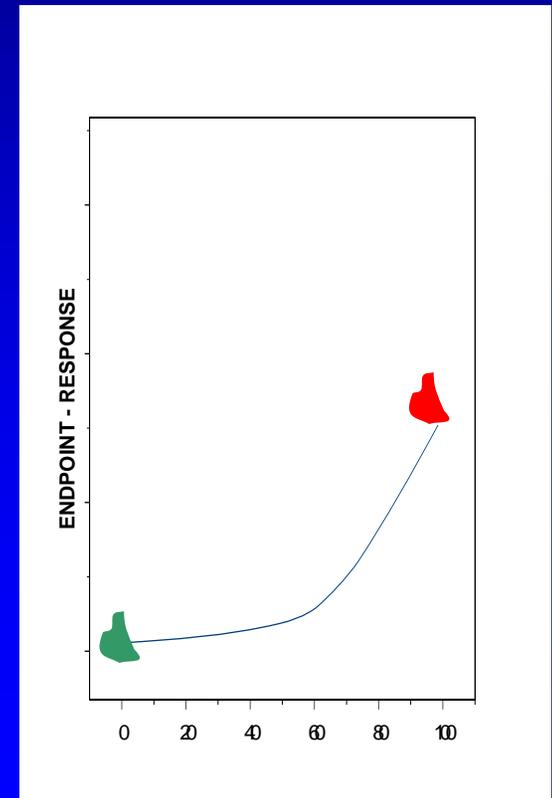
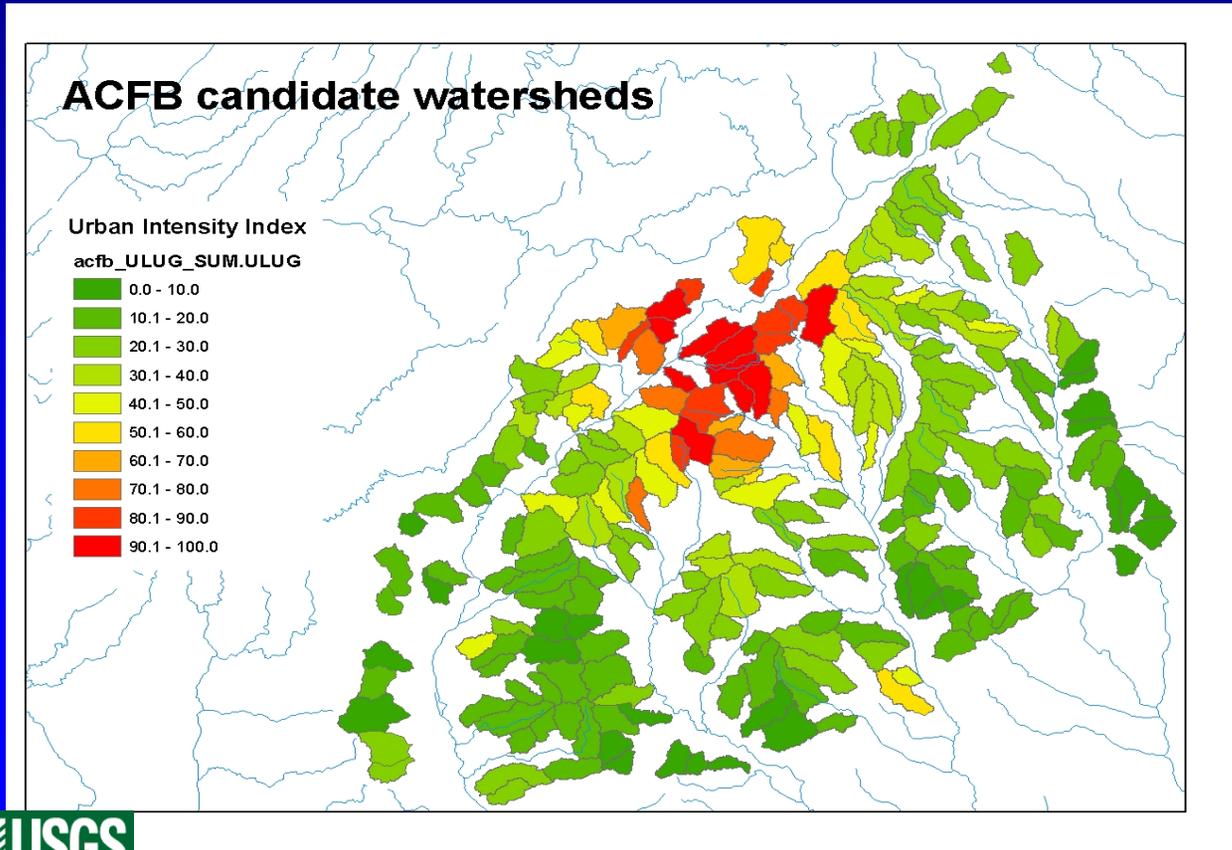
Endpoints

Results



# Design

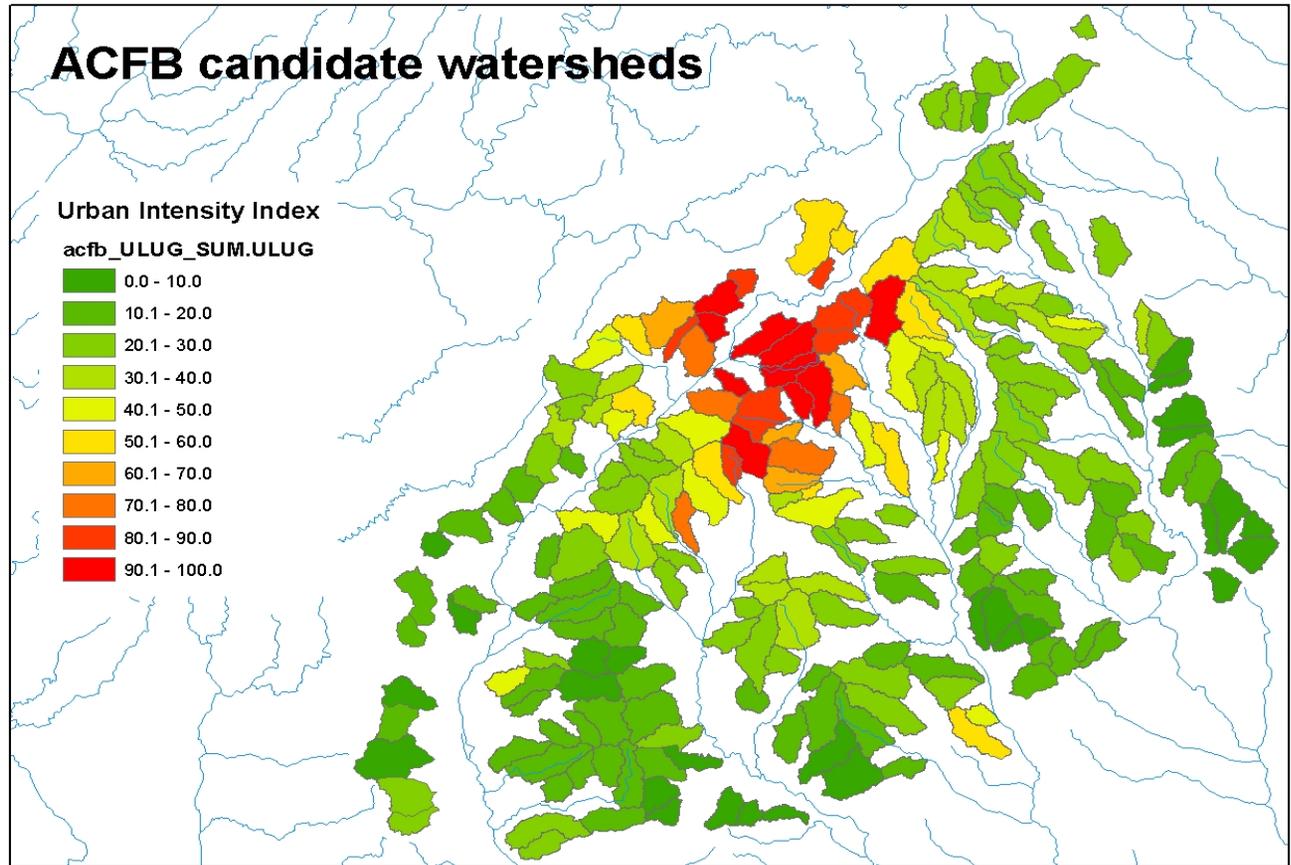
- Range of urban intensity
- Minimize confounding factors
- Chemical, Physical, Biological Endpoints



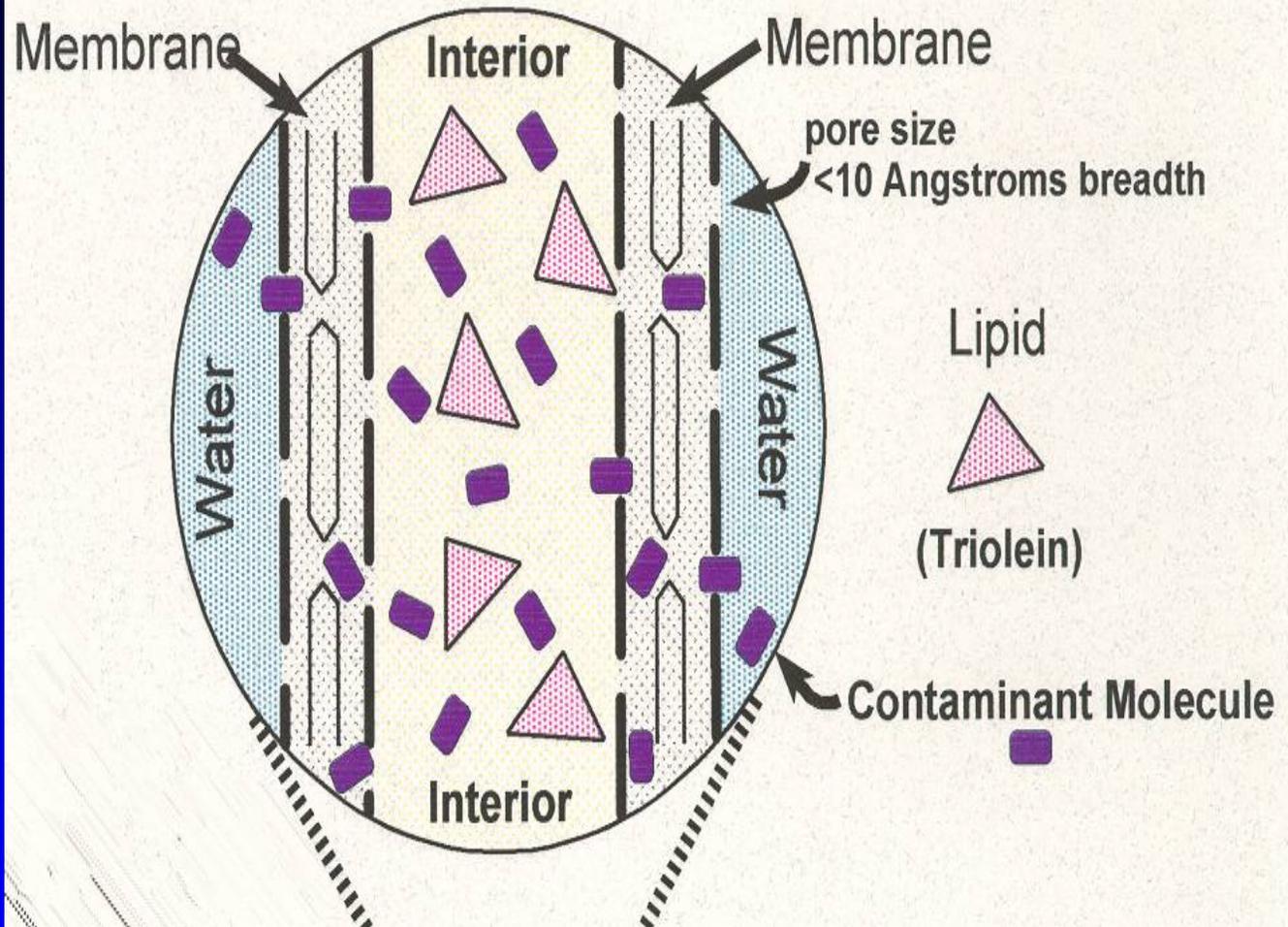
# Design

- 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**

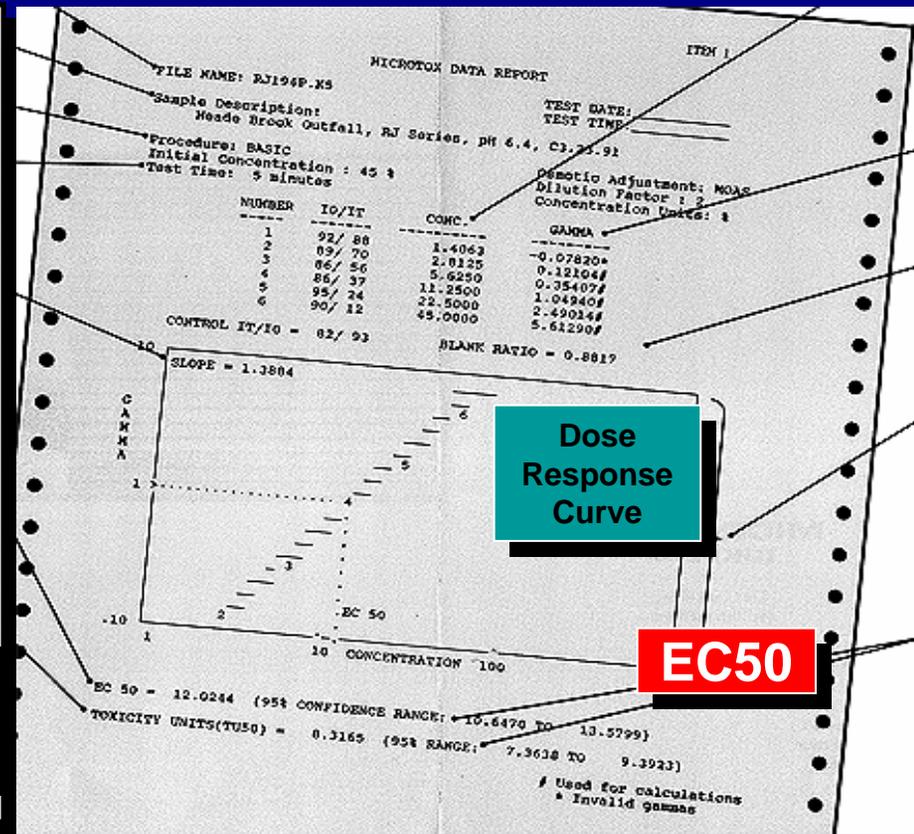
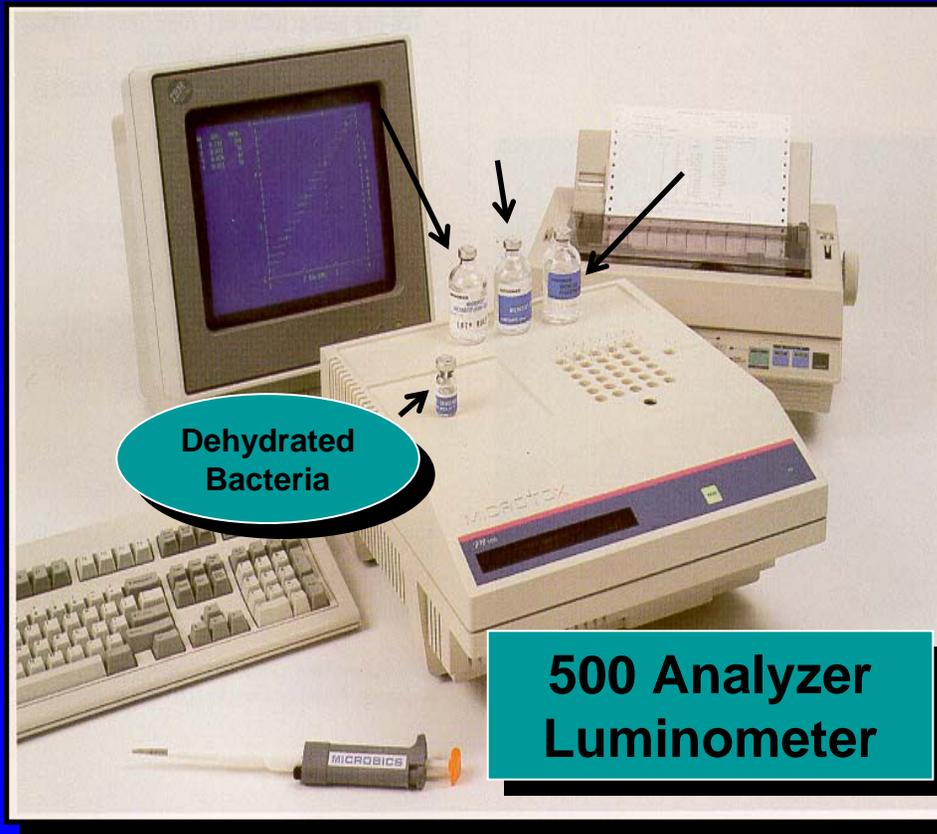


# Endpoints

## Microtox<sup>R</sup>

## Toxicity

## EC50

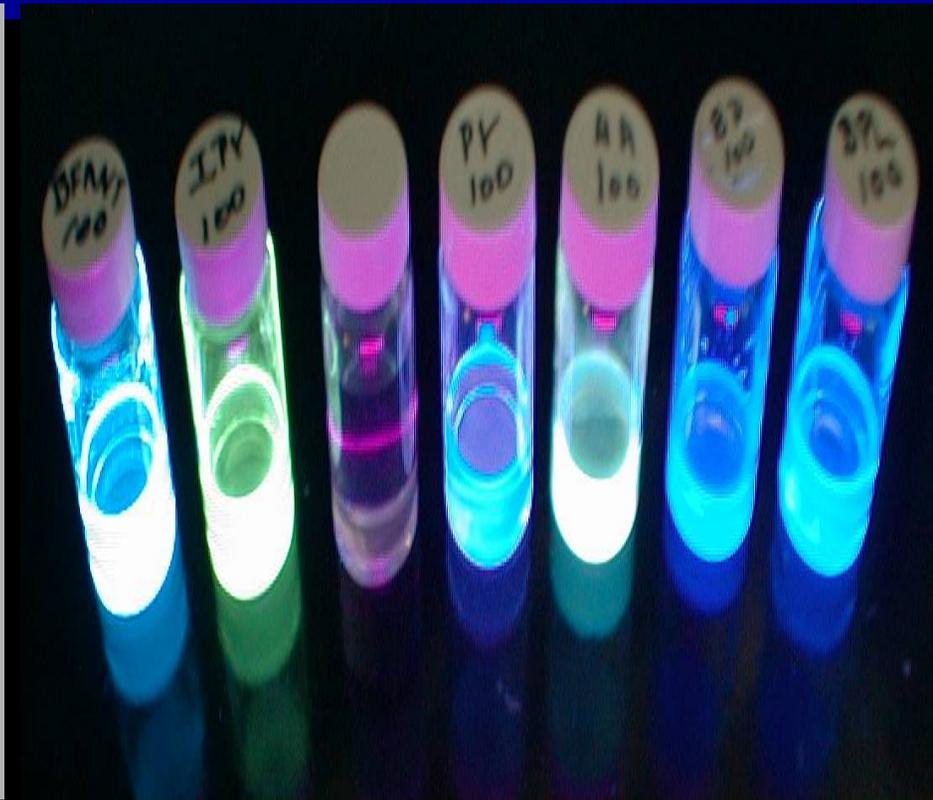


# Endpoints

## Fluoroscanner

“Total” PAHs

Pyrene equivalents



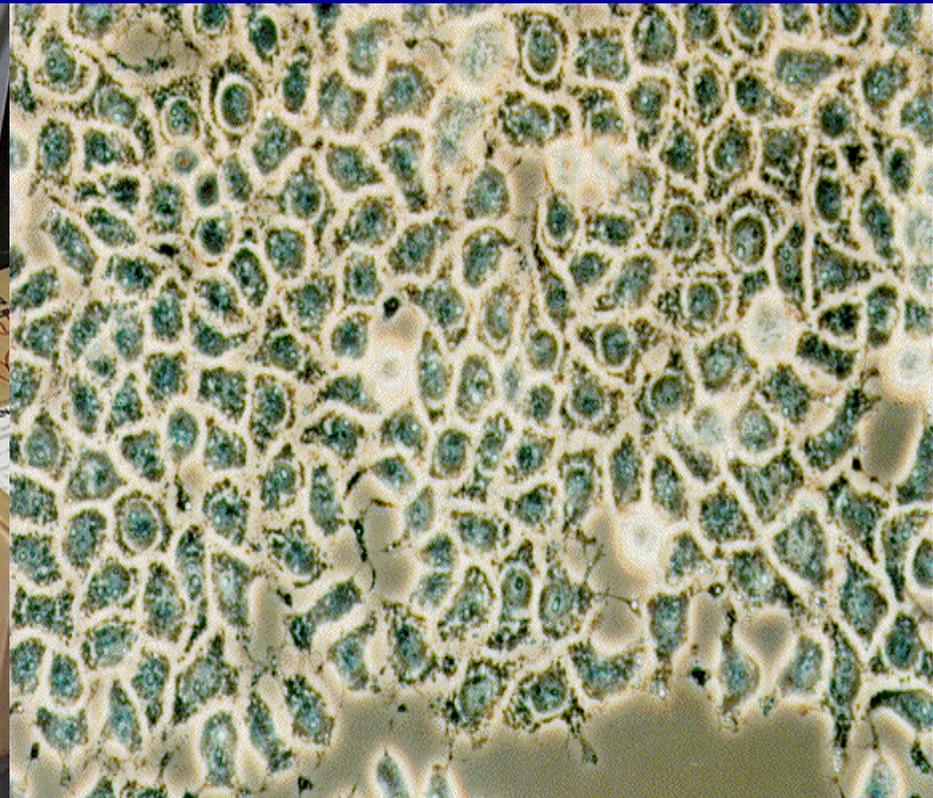
# Endpoints

## CYP1A1

Cellular enzyme induction

pgTEQ/SPMD

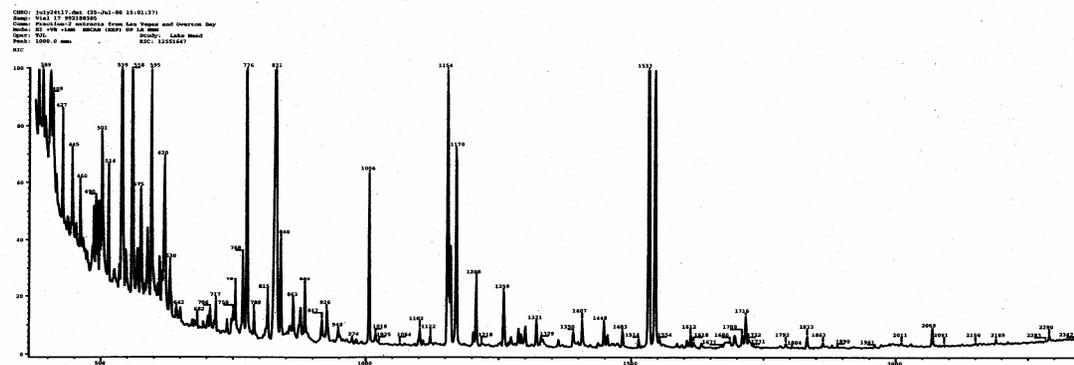
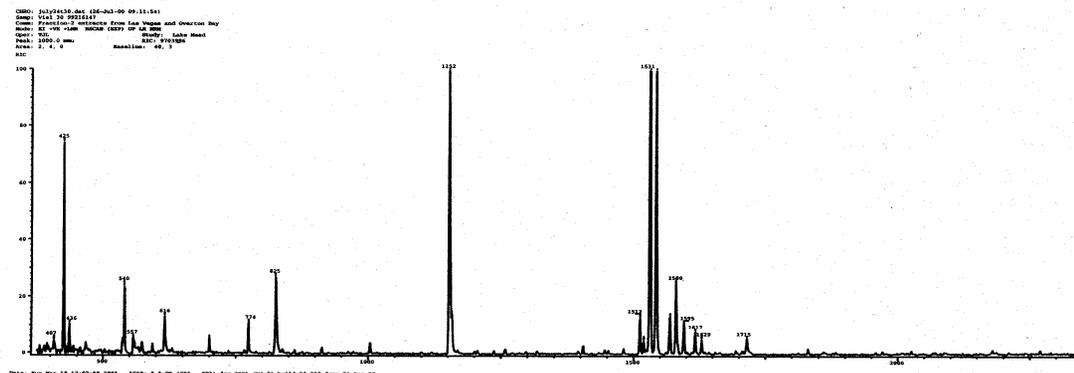
Dioxins, Furans, PCBs, PAHs



# Endpoints

Analytical Chemistry

Concentration of knowns - standards  
Identified some unknown peaks



**Are there differences in Microtox<sup>®</sup>, Fluoroscan and CYP1A1 along a gradient of urban intensity?**

**Do results support analytical chemistry?**

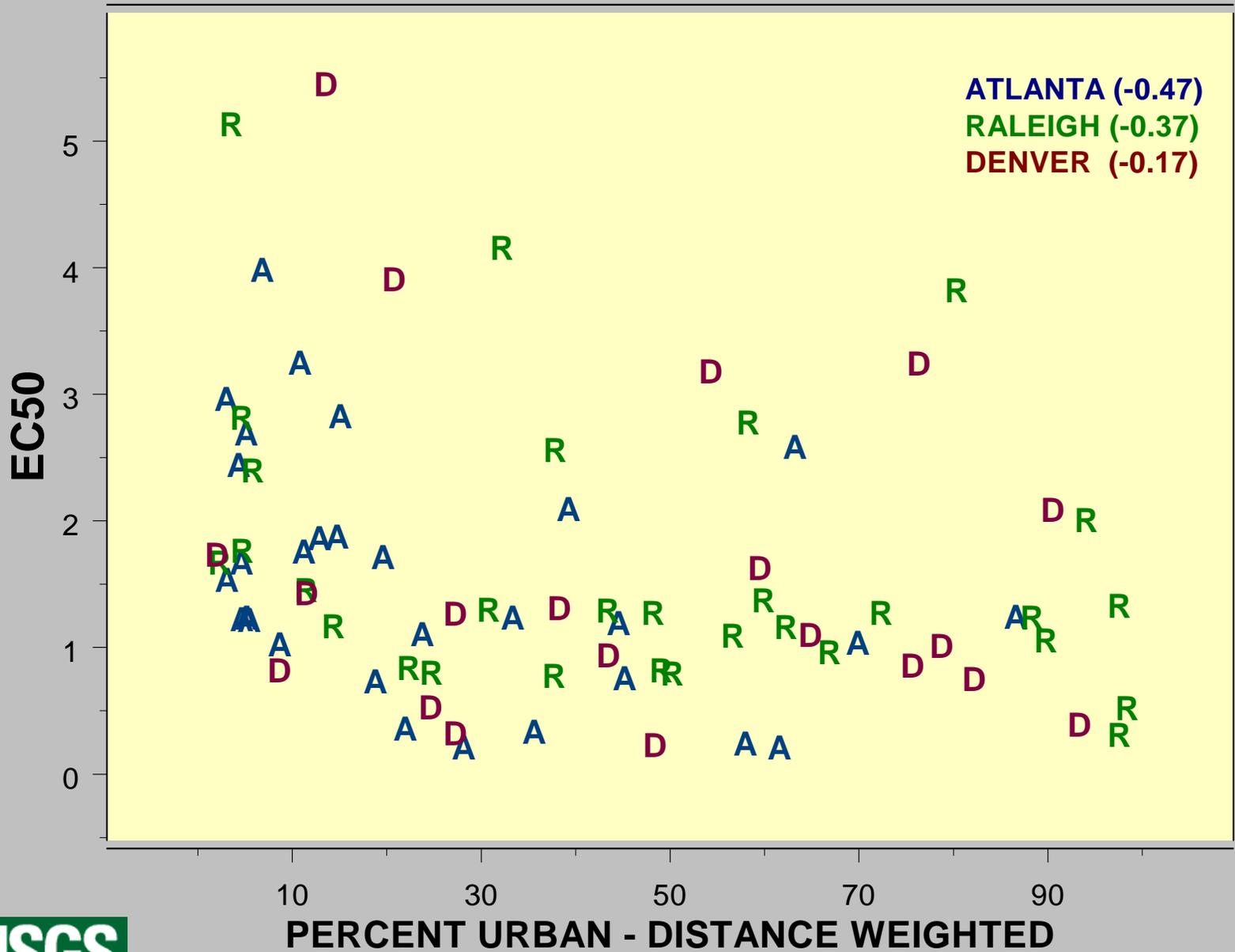
**How do results compare across environmental settings?**



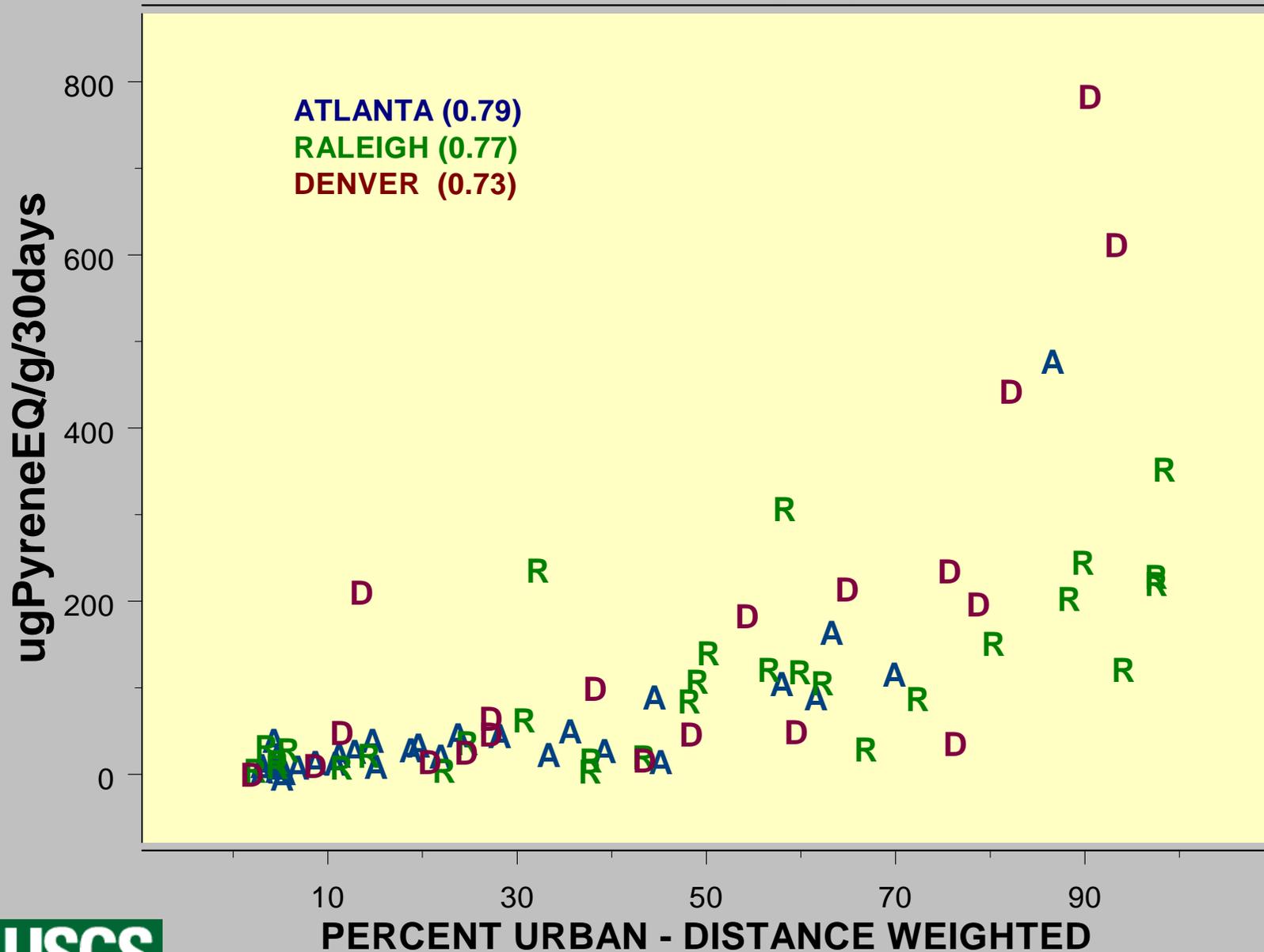
# Results



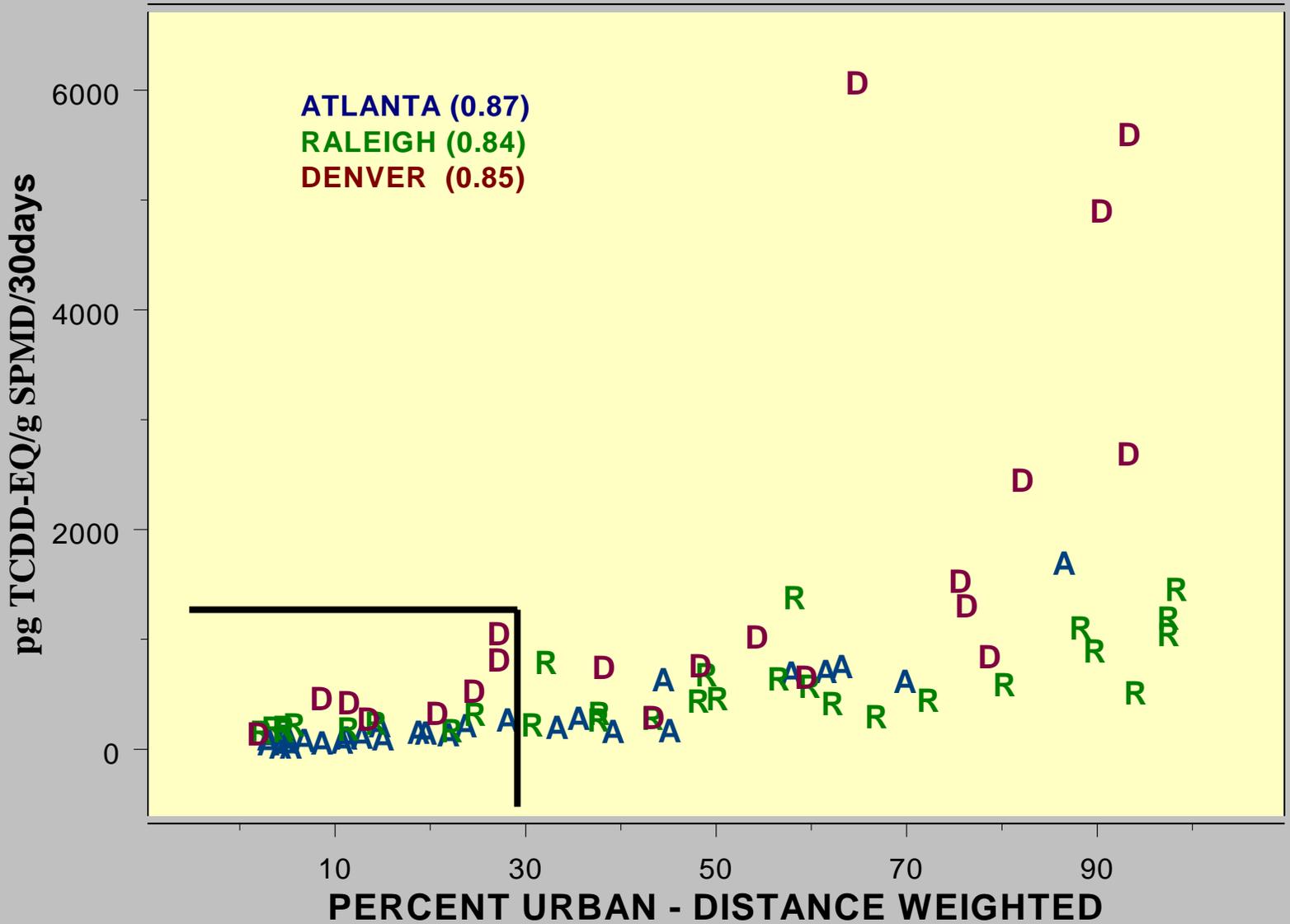
# Microtox (-0.33)



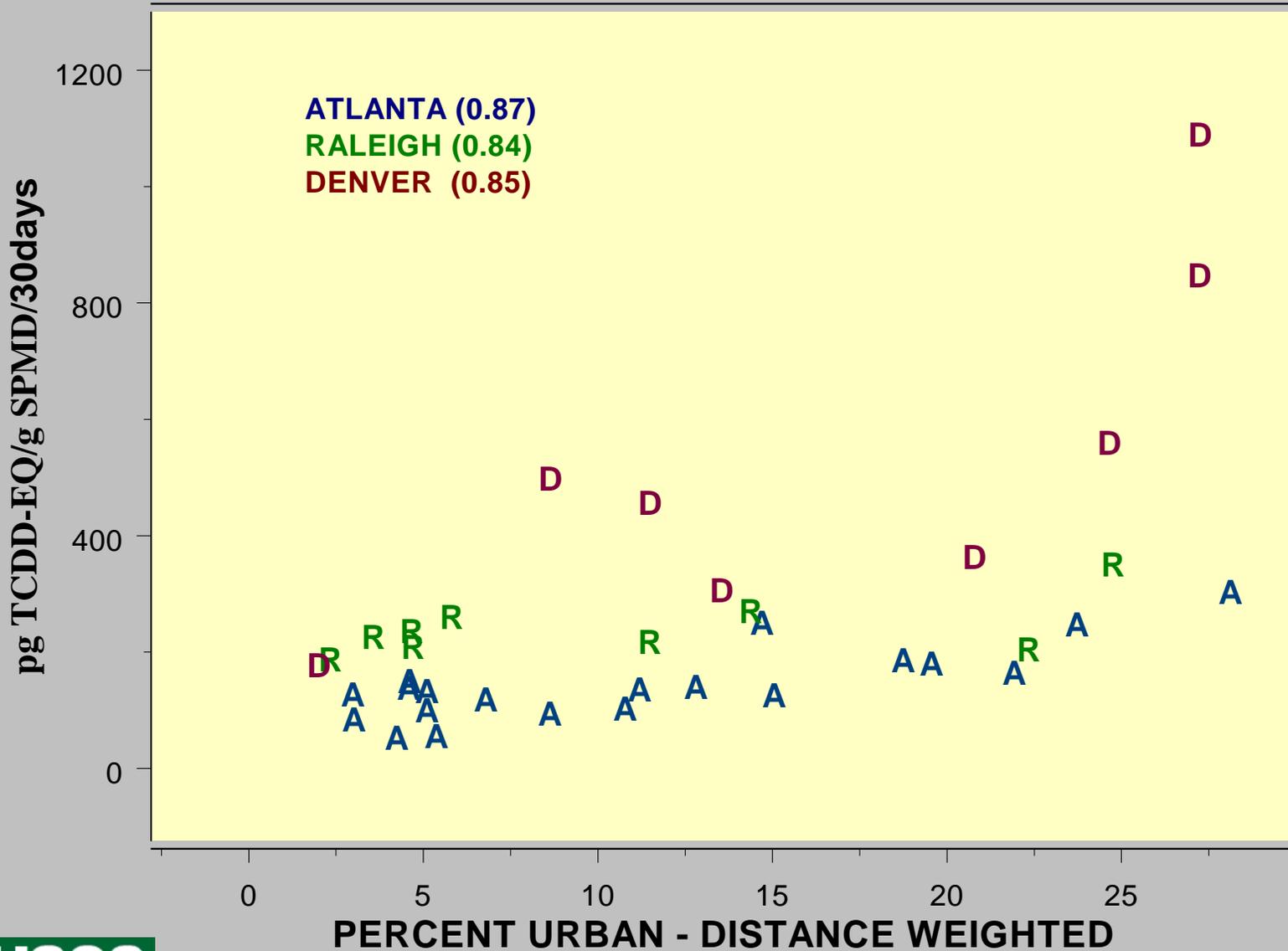
# FLUOROSCAN (0.80)



# 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**

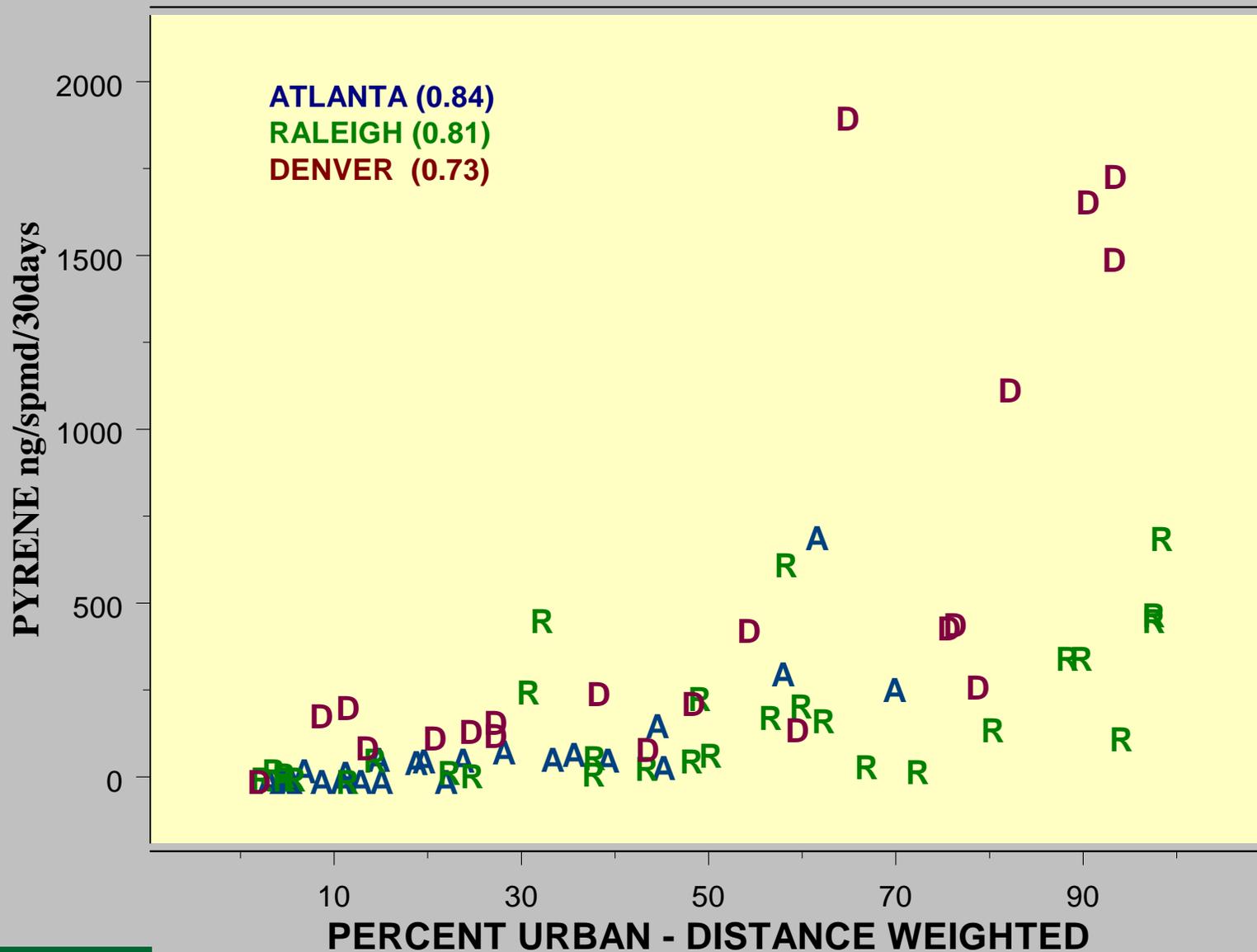
**22 compounds correlated with urban land use**



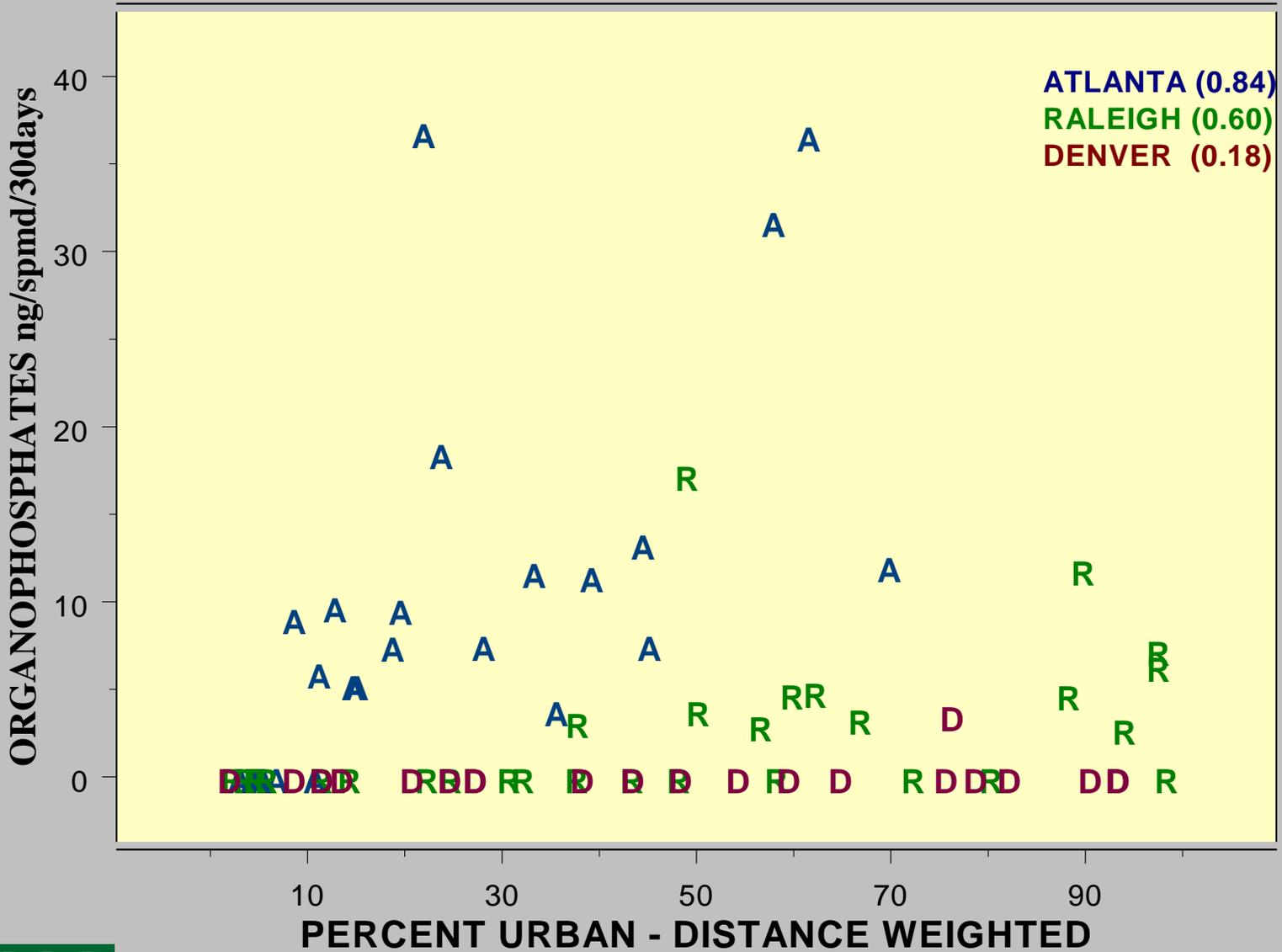
# NUMBER OF DETECTS VS PERCENT URBAN DISTANCE WEIGHTED (0.70)



# PYRENE VS PERCENT URBAN DISTANCE WEIGHTED (0.80)



# ORGANOPHOSPHATES VS PERCENT URBAN DISTANCE WEIGHTED (0.24)



# Are there differences in Microtox<sup>r</sup>, 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[det]phenathrene	PAH			
Benzo(b)naphtho [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	High	Low	Low
Chlorpyrifos	Pesticide	High	Low	Low
DCPA	Herbicide	Low	High	Low
AHTN	Musk	Low	Low	High
Benz [c] acridine	PAH	Low	High	Low
Trimethyl naphthalene	PAH	Low	High	Low
Chlordane	OC- Insecticide	Low	Low	High
Total Substituted PAH	PAH-substituted	High	Low	Low
Total N PAH	PAH-Nitrogen	Low	High	Low
Total Herbicides	Herbicides	High	Low	Low
Total Organophosphates	Organophosphates	High	Low	Low

# 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

