Pesticides in Urban Streams and the Washington DC Area

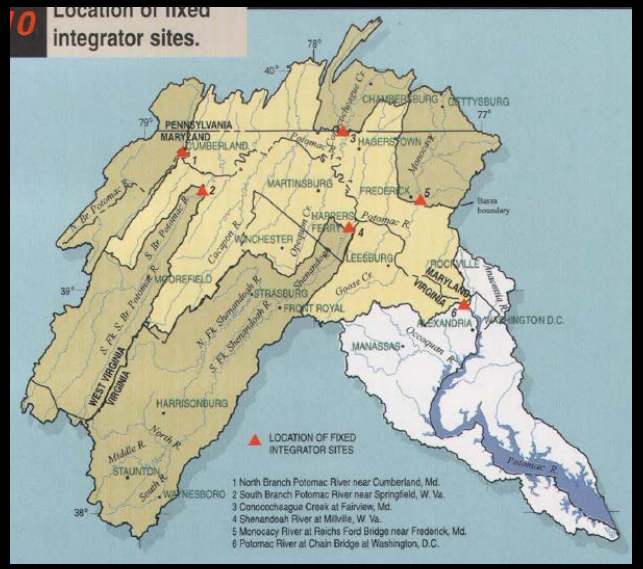
1. Monitoring for pesticides
2. Occurrence of pesticides in streams
3. Changes over time
4. Effects of pesticides

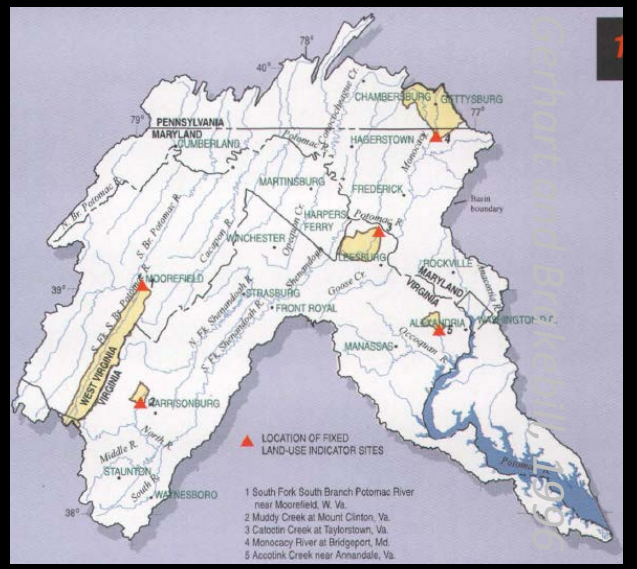
Scott Ator, Brandon Fleming, Gary Rowe, Charles Crawford, Lisa Nowell, and Peter Van Metre

USGS

Pesticide Monitoring through NAWQA

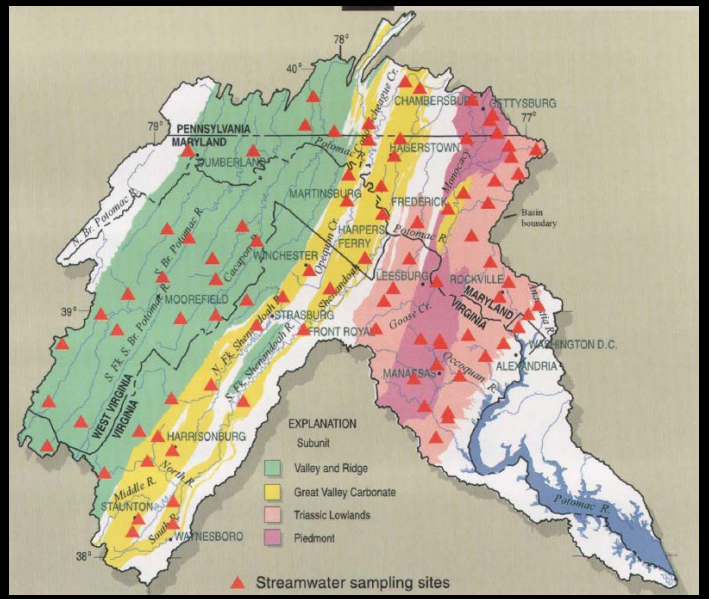
- Piloted in the late 1980s, with full national roll-out in 1991
- Uses low-level information-rich analytical methods
- Many current and legacy-use compounds and degradates
- Includes continuing fixed-frequency monitoring of streams in different settings





Pesticide Monitoring through NAWQA

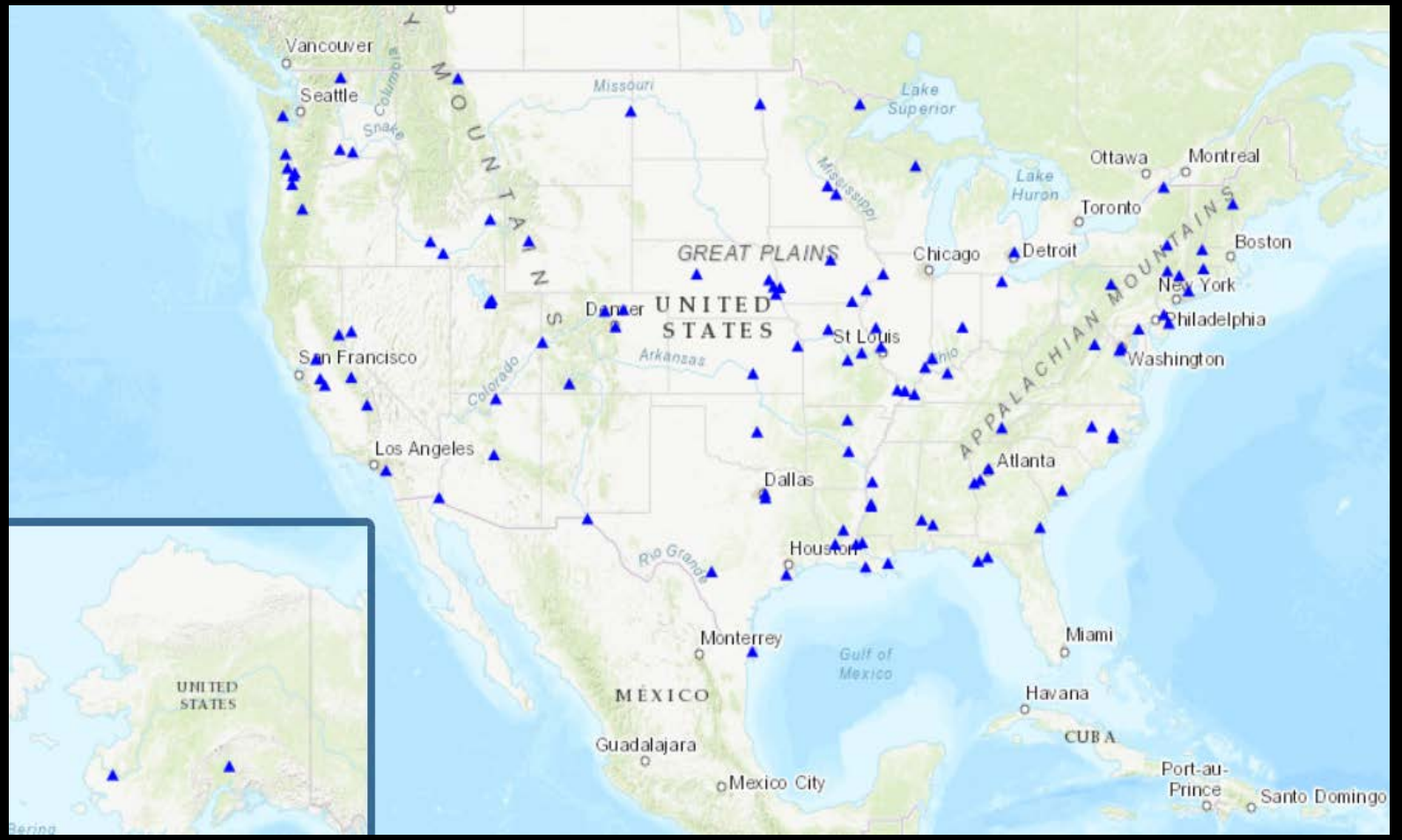
- Includes synoptic studies of occurrence and distribution in streams, groundwater, sediment, and organisms in different regions during different hydrologic conditions
- Includes focused fate and transport studies



Gerhart and Brakebill, 1996

Current National Surface-Water Network

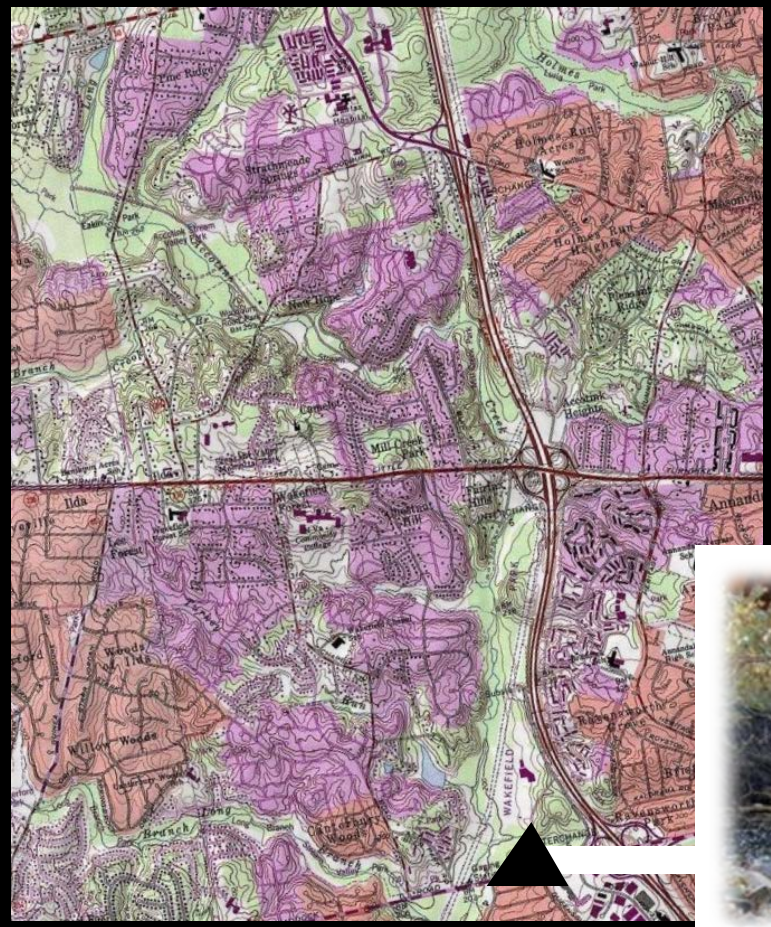
Pesticide concentrations and occurrence data for >200 compounds at (currently) 77 stream sites

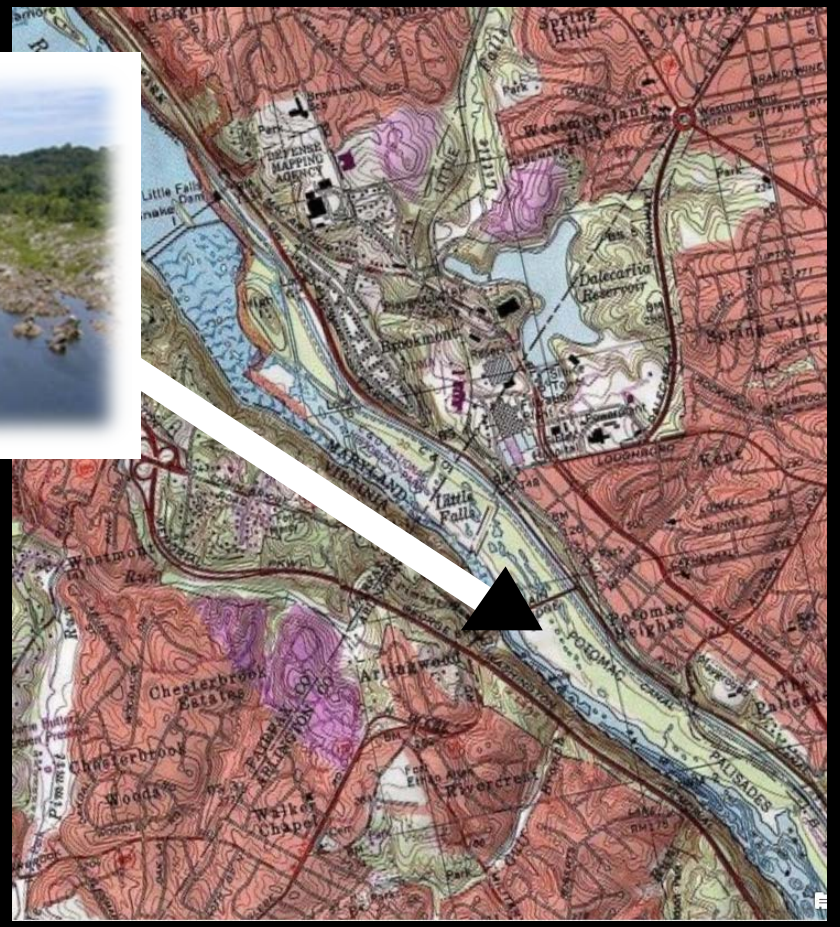


https://cida.usgs.gov/quality/rivers/home

USGS

Current National Surface-Water Network





Accotink Creek, 62 km^2

Potomac River, 30,000 km^2

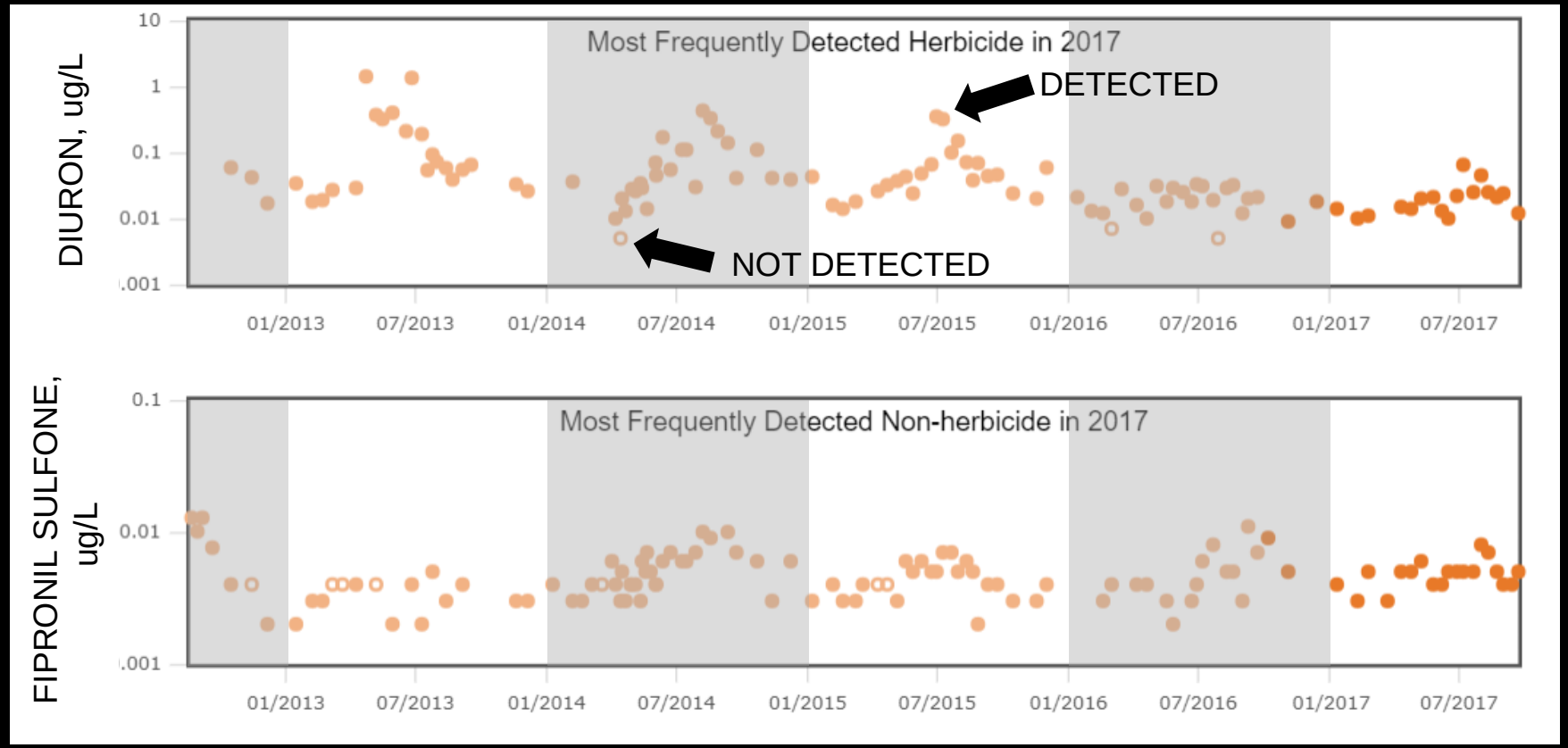
USGS

Occurrence of Pesticides in Streams

Pesticides are commonly found in streams draining areas of use

Seasonal patterns related to application practices are common

Accotink Creek, 62 km^2



https://cida.usgs.gov/quality/rivers/home

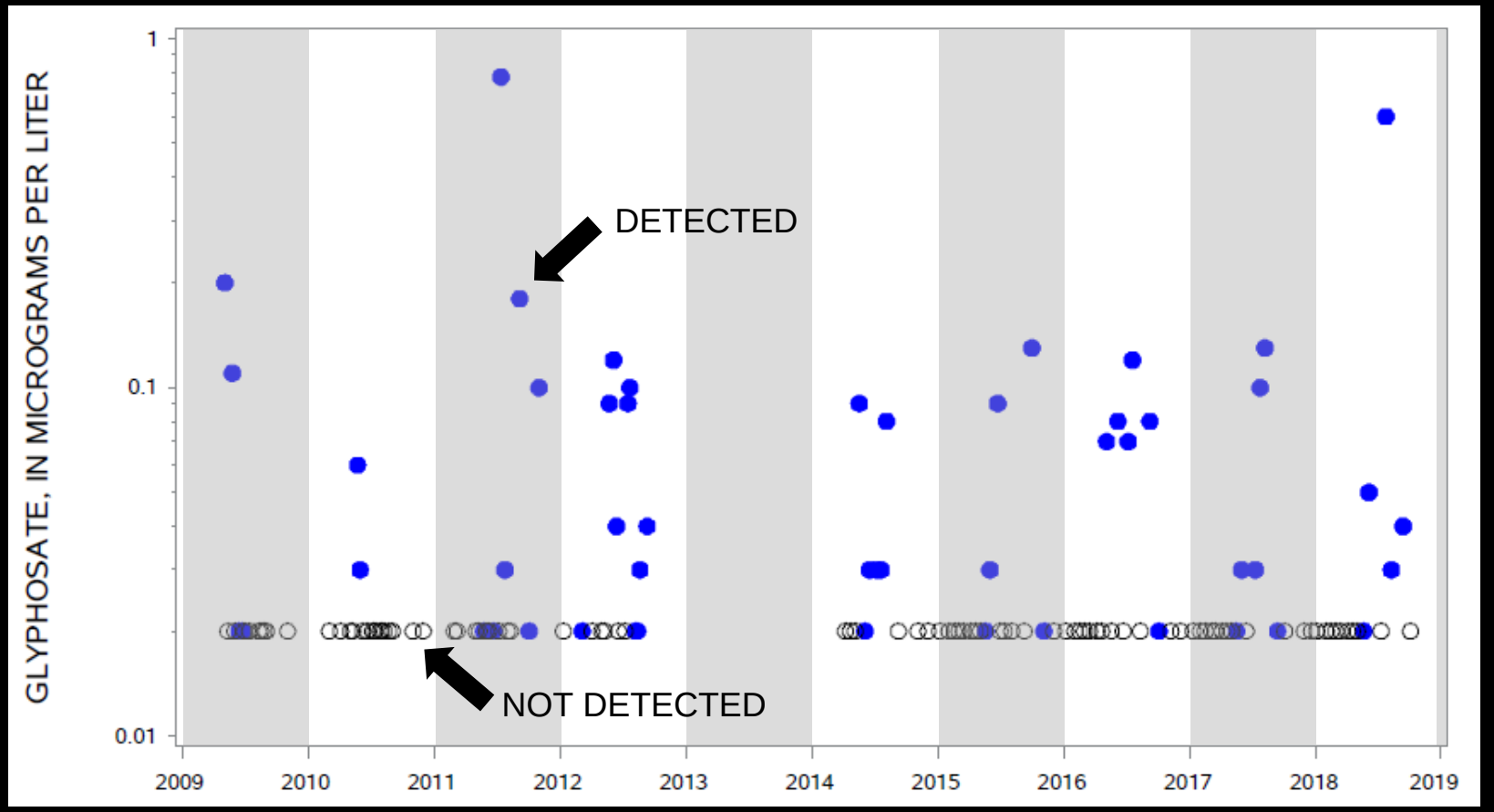
USGS

Occurrence of Pesticides in Streams

Pesticides are commonly found in streams draining areas of use

Seasonal patterns related to application practices are common

Potomac River, 30,000 km^2



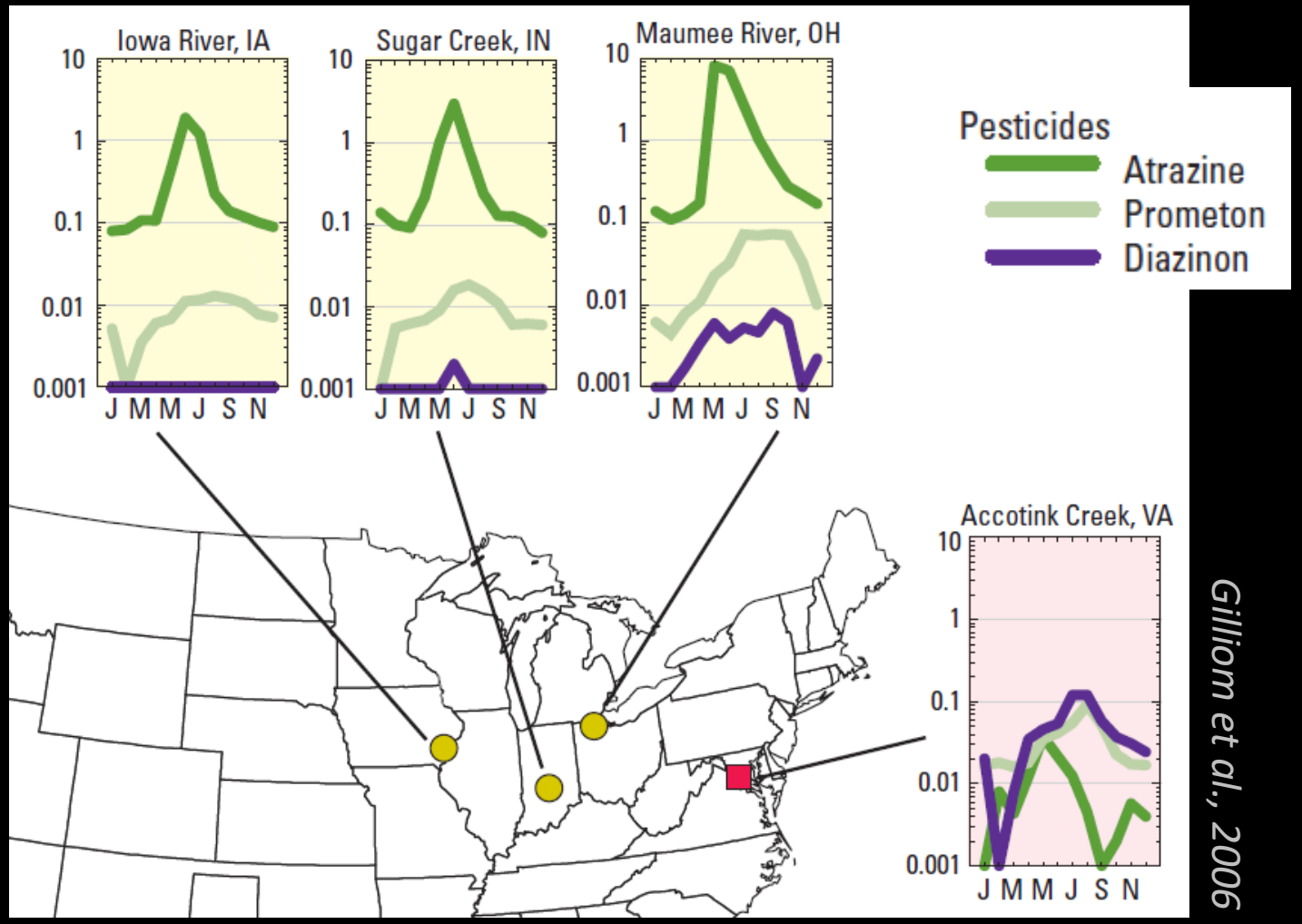
https://waterdata.usgs.gov

USGS

Occurrence of Pesticides in Streams

Pesticides are commonly found in streams draining areas of use

Seasonal patterns related to application practices are common

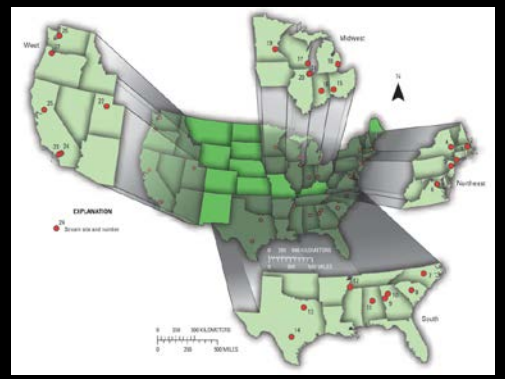


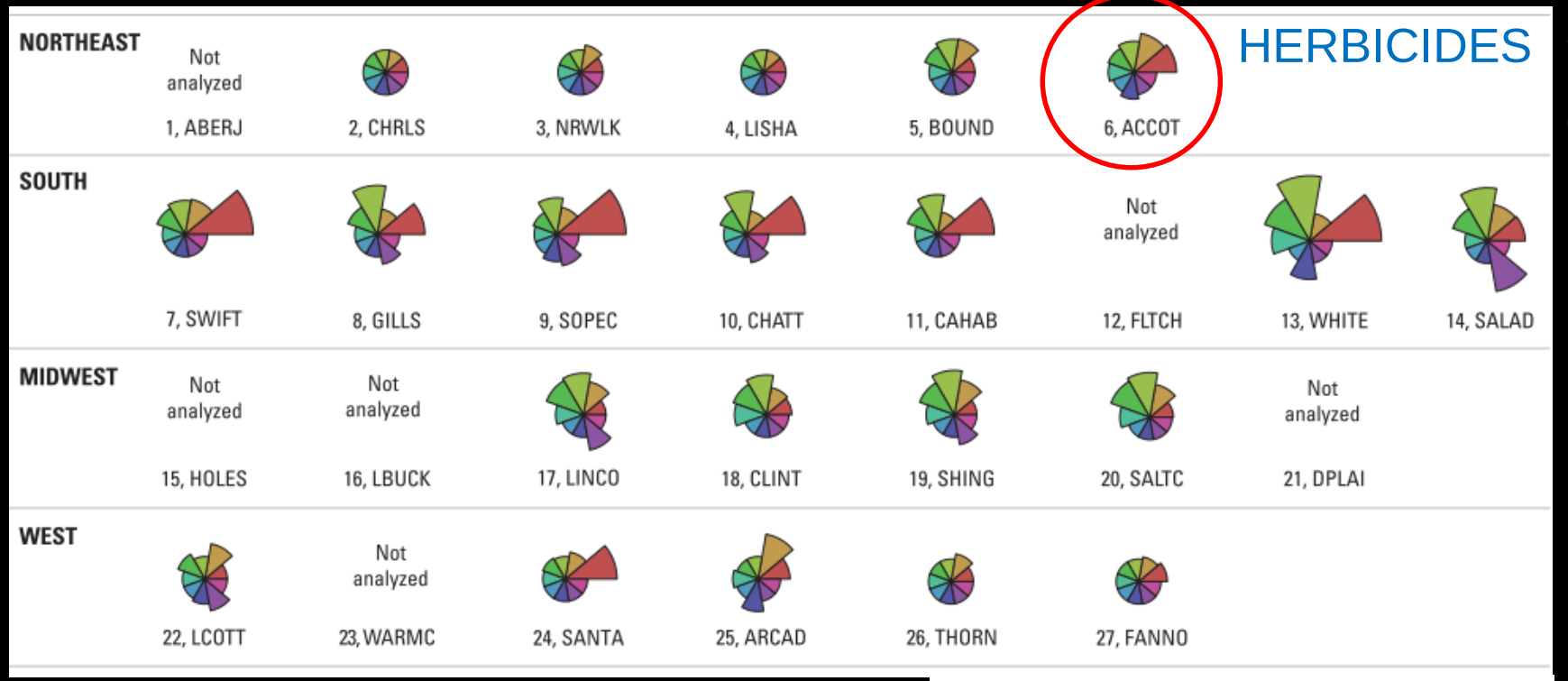
Gilliom et al., 2006

USGS

Occurrence of Pesticides in Streams

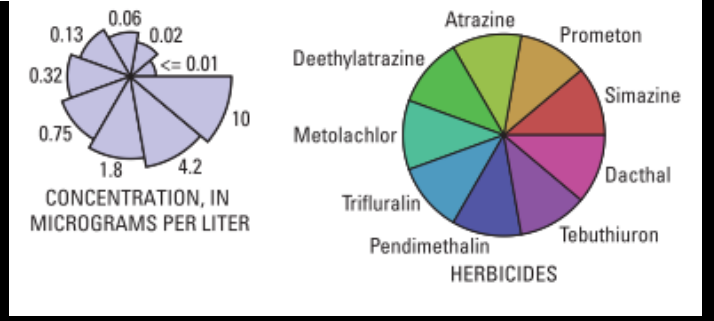
Pesticides are commonly found in streams draining areas of use





Ryberg et al., 2010

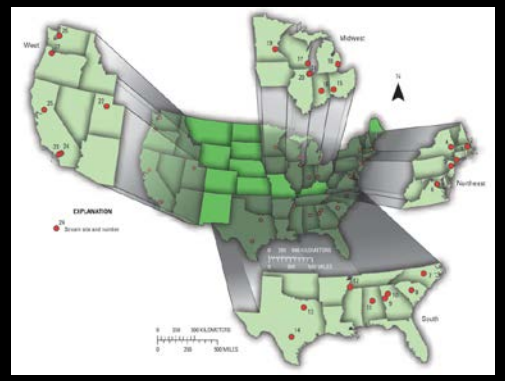
Estimated 90th percentile concentration, 2000 - 2008

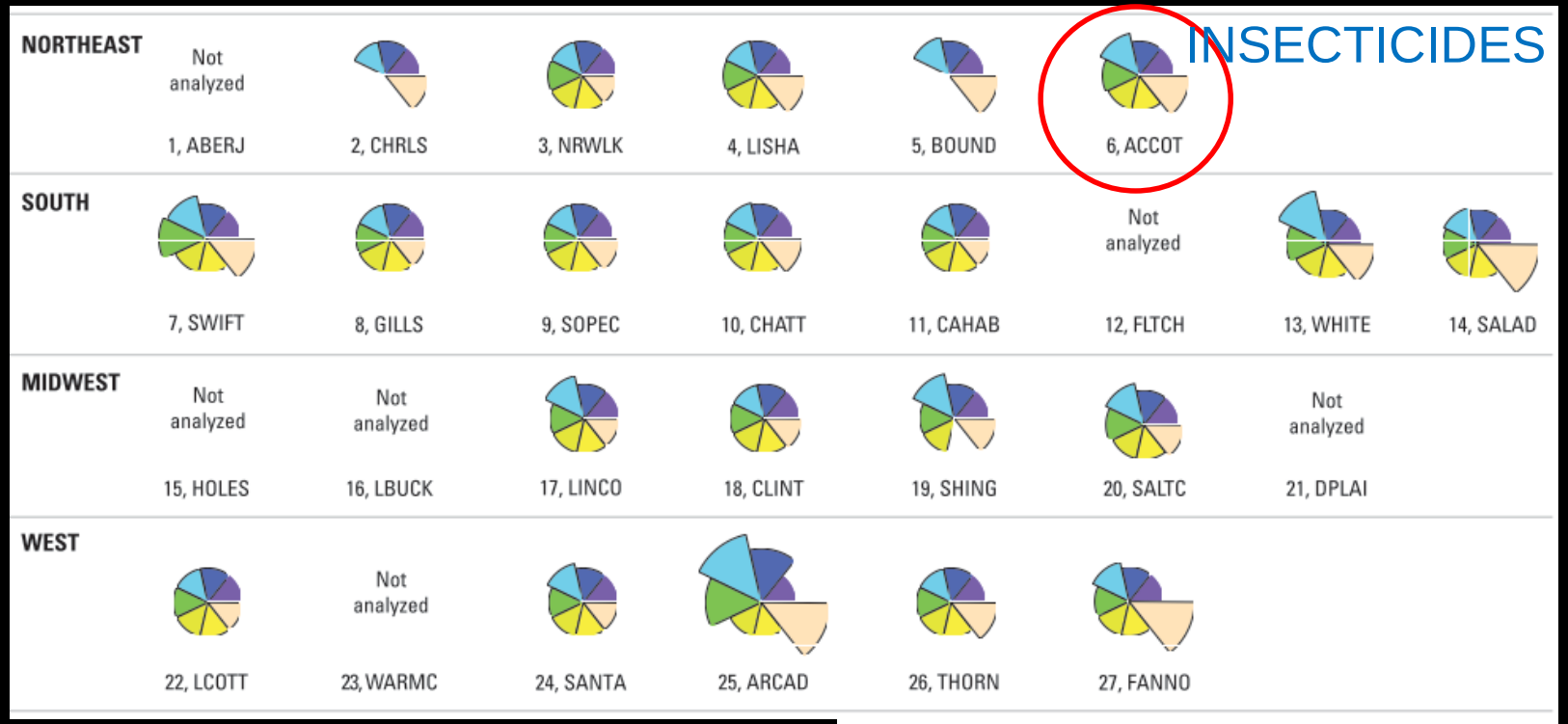


USGS

Occurrence of Pesticides in Streams

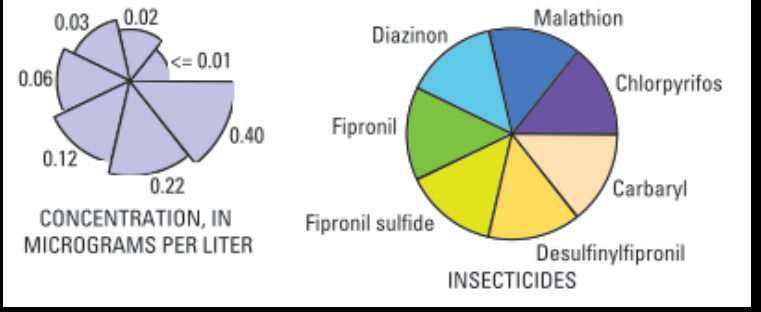
Pesticides are commonly found in streams draining areas of use





Ryberg et al., 2010

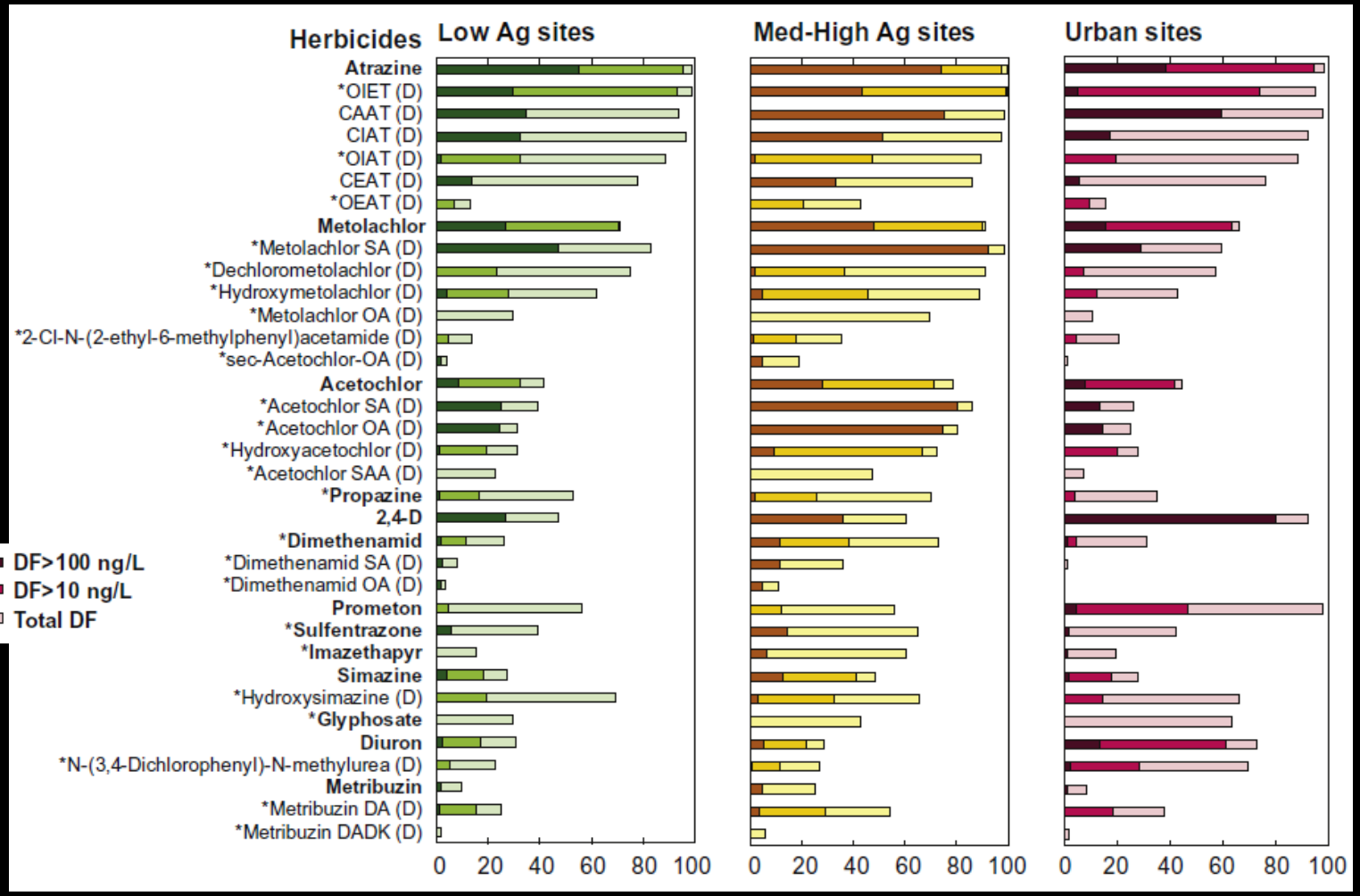
Estimated 90th percentile concentration, 2000 – 2008



USGS

Occurrence of Pesticides in Streams

In some cases, degradate compounds are more common than parent compounds.

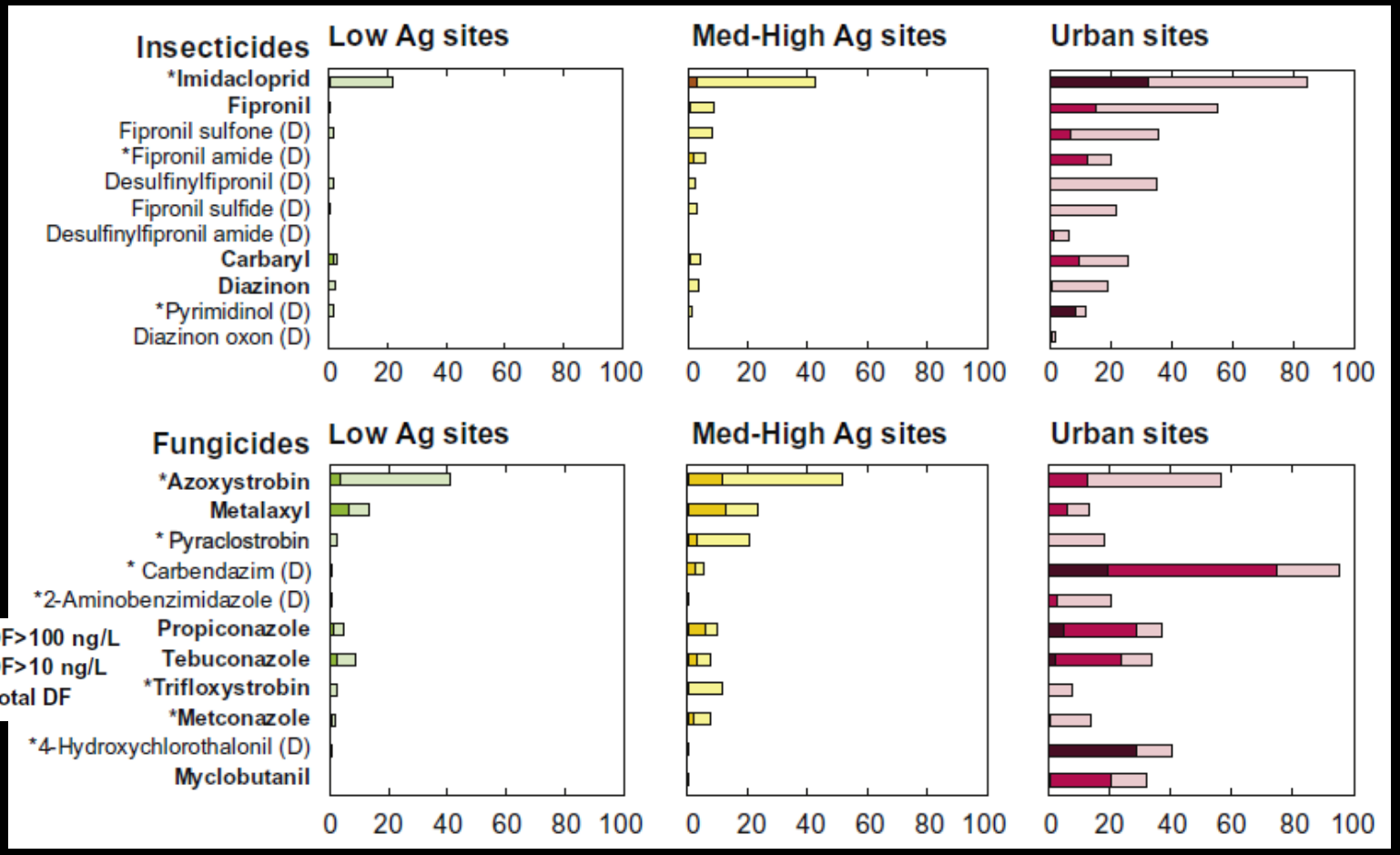


Nowell et al., 2017

USGS

Occurrence of Pesticides in Streams

Insecticides and fungicides are often more commonly detected in urban streams.

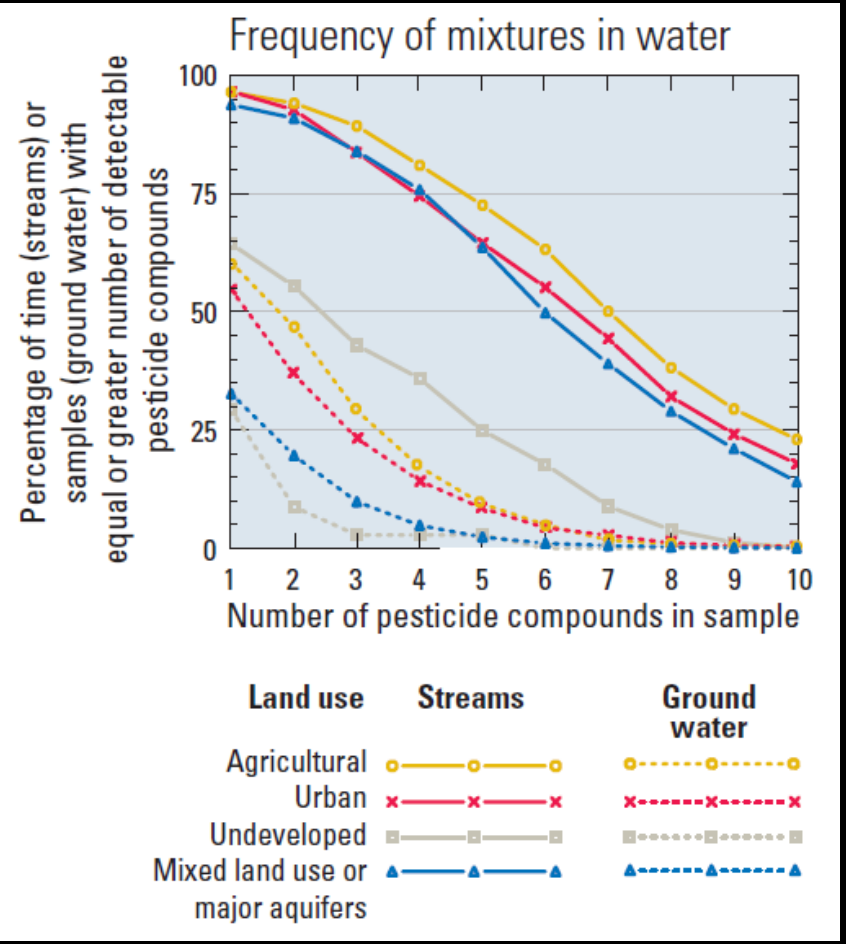


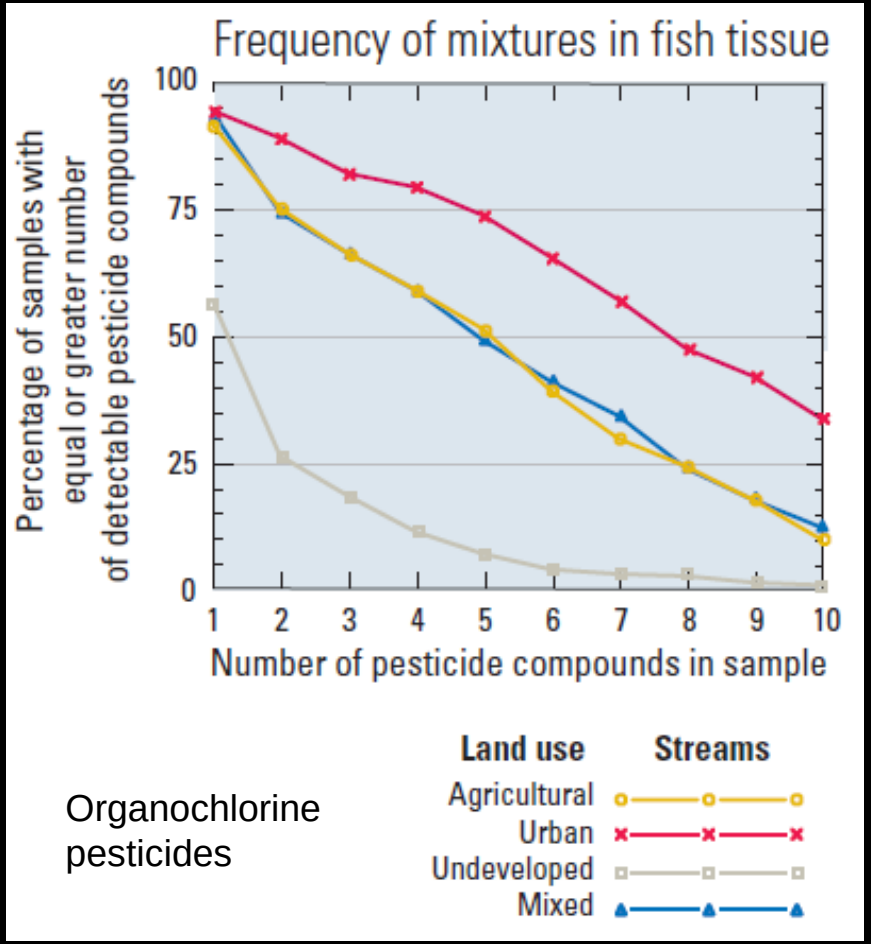
Nowell et al., 2017

USGS

Occurrence of Pesticides in Streams

Mixtures are common





Organochlorine pesticides

Gilliom et al., 2006

USGS

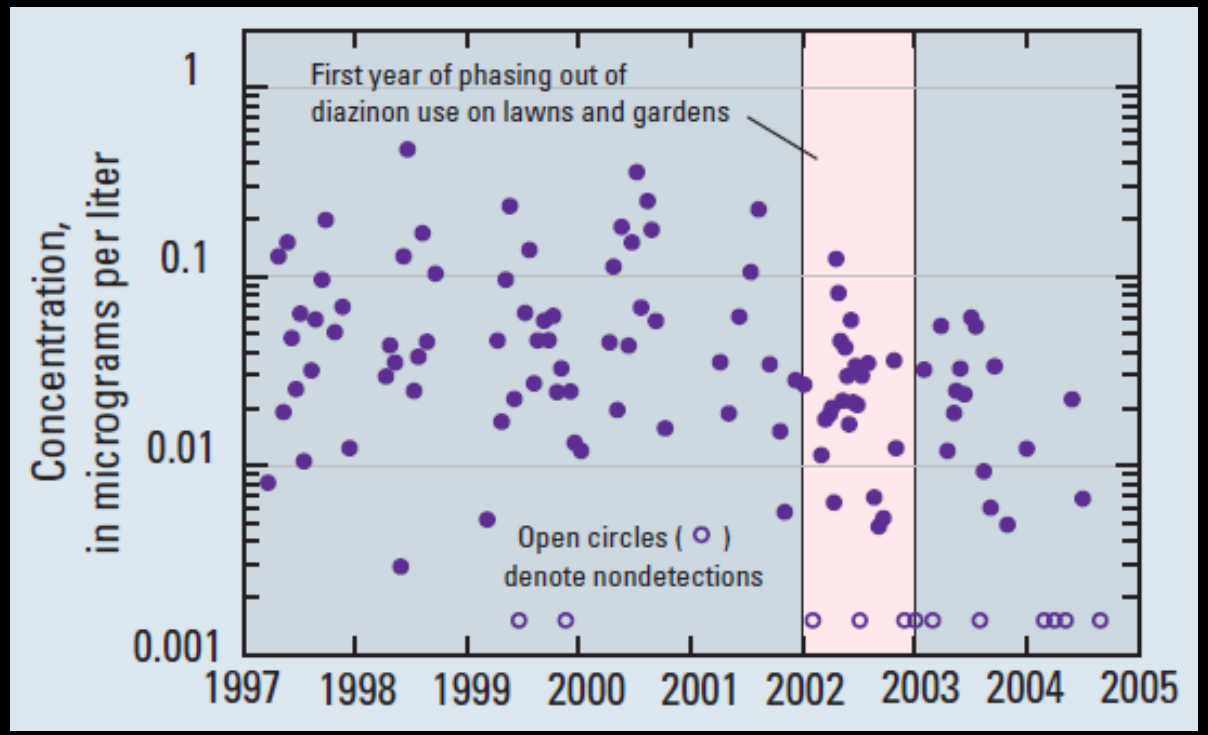
Changes Over Time

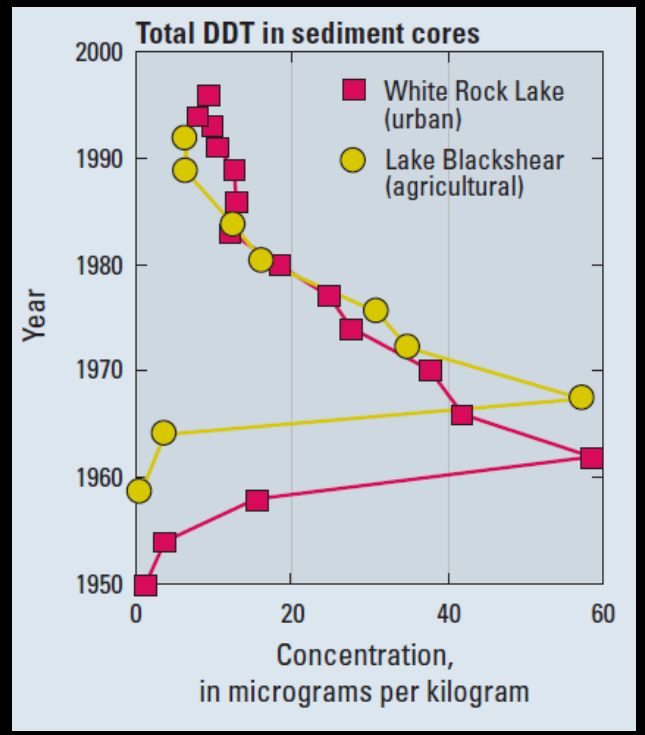
Pesticide trends reflect changes in usage.

Non-agricultural use of diazinon was phased out from 2002-2004.

Use of DDT was cancelled in the early 1970s.

Diazinon in Accotink Creek



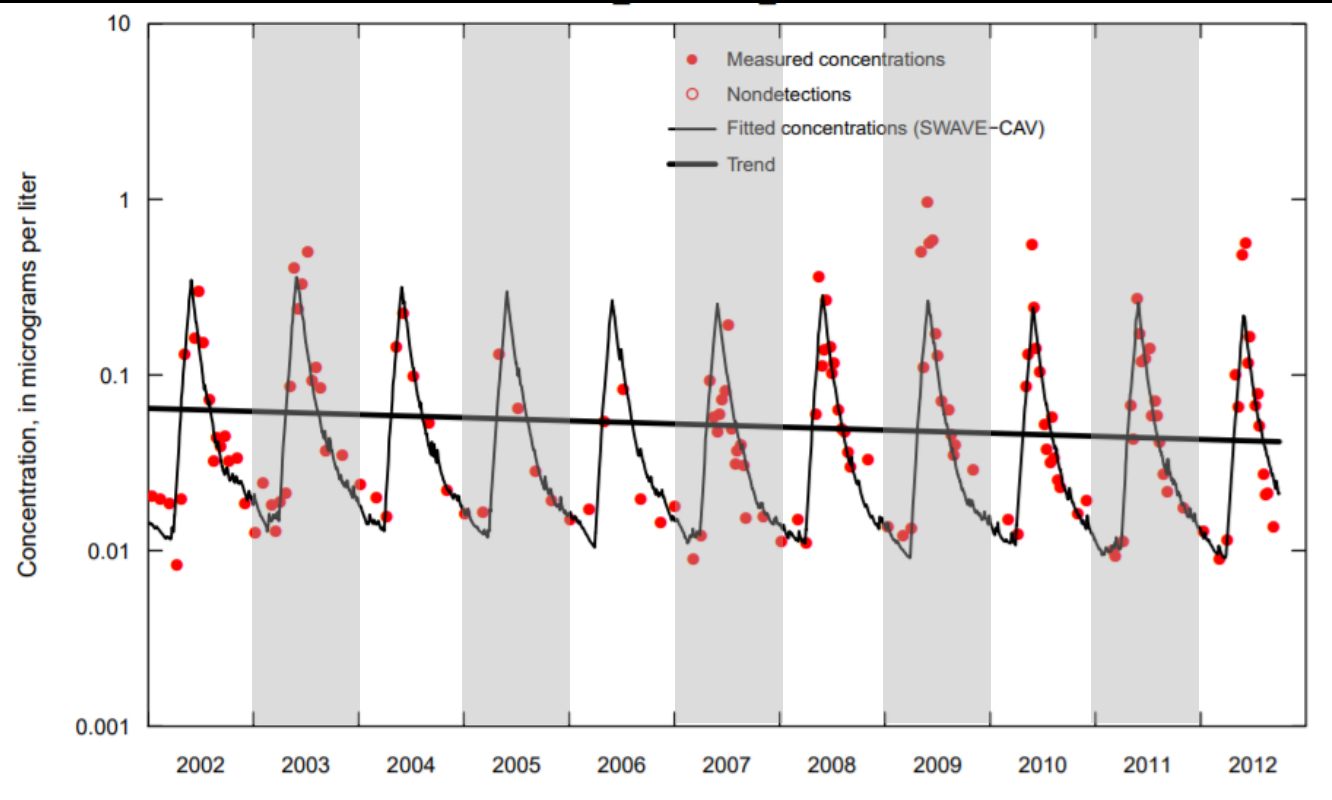


Gilliom et al., 2006, Phillips et al., 2007

USGS

Changes Over Time

Atrazine in the Potomac River



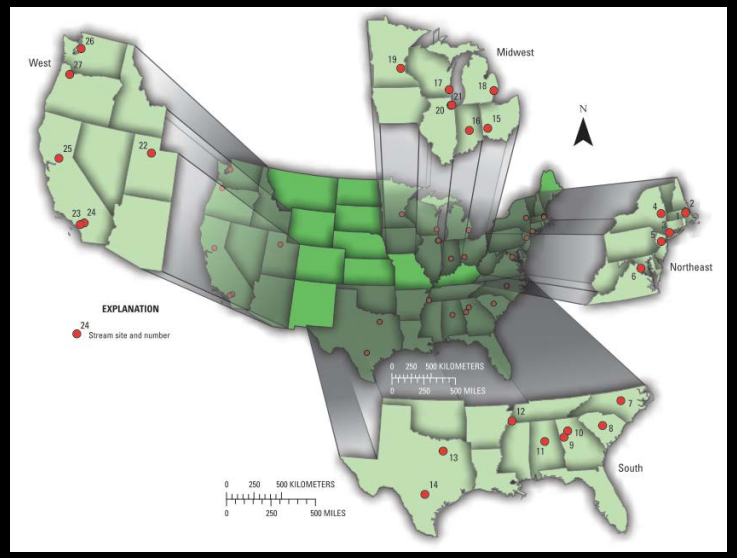
https://nawqatrends.wim.usgs.gov/swtrends/, Ryberg et al., 2010

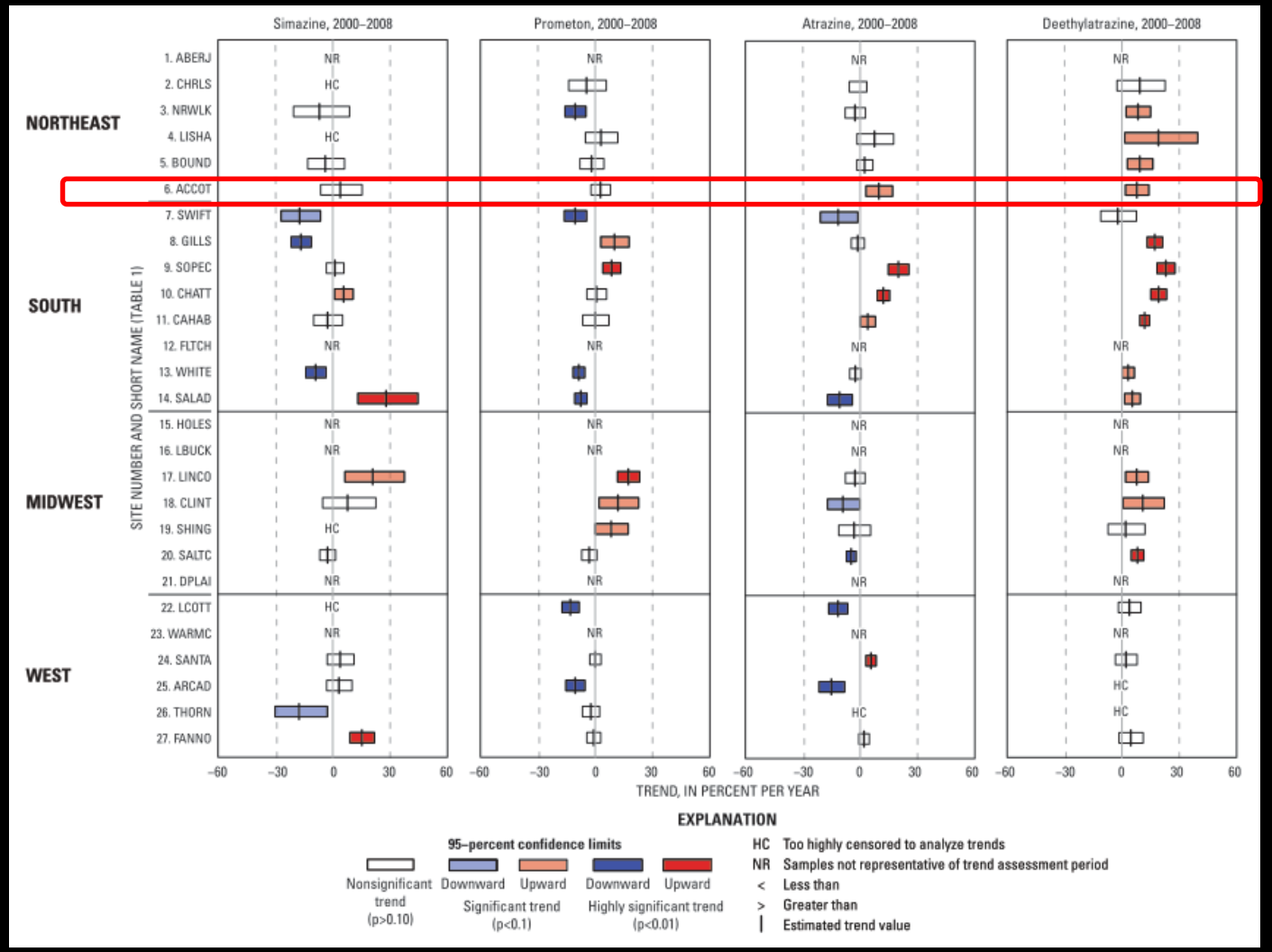
Compound	Significant or Highly Likely Trends (%)	
	Potomac 2002-2012	Accotink 2000-2008
Simazine	-24	NS
Prometon	18	NS
Deethylatrazine	-9	8
Metolachlor	NS	NS
Atrazine	-33	10
Acetochlor	88	
Trifluralin		NS
Pendimethalin		-6
Fipronil	-46	20
Fipronil sulfide	NS	14
Desulfinylfipronil	NS	21
Tebuthiuron	NS	
Carbaryl	NS	-10
Diazinon		-43

USGS

Changes Over Time

Trends in herbicide concentrations in urban streams, 2000-2008



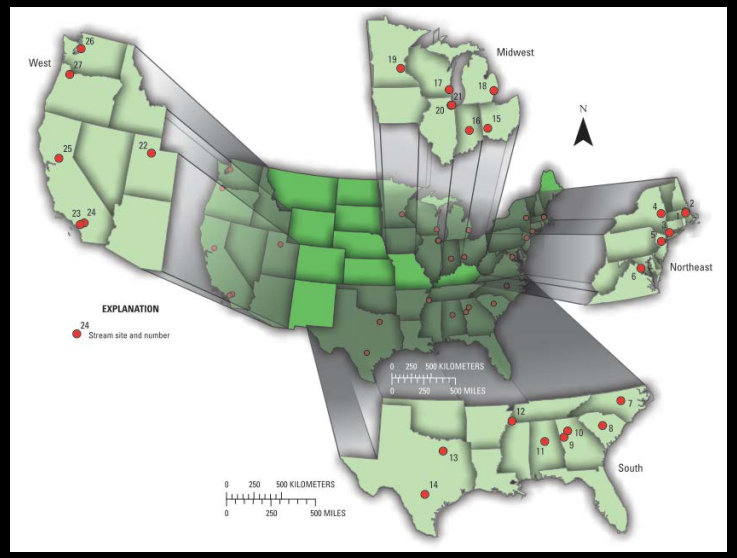


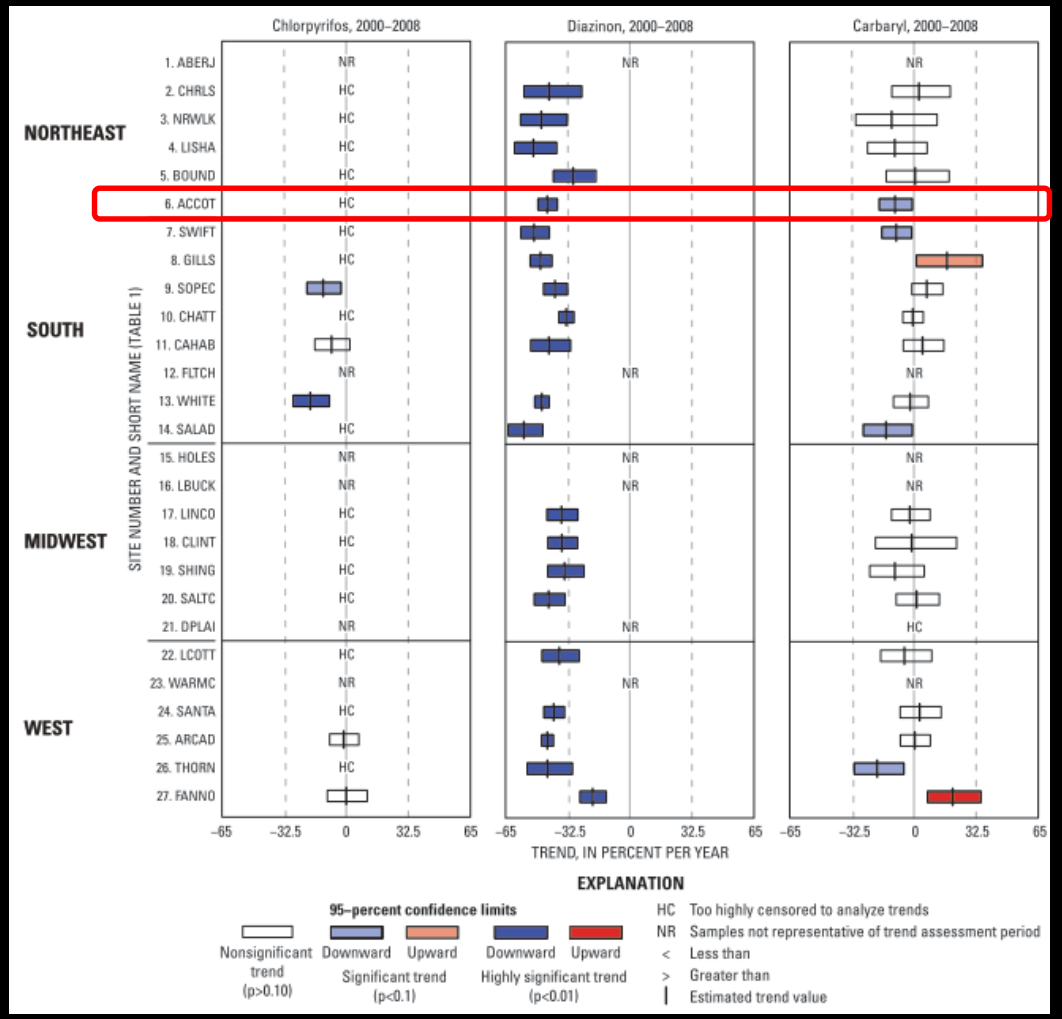
Ryberg et al., 2010

USGS

Changes Over Time

Trends in insecticide concentrations in urban streams, 2000-2008





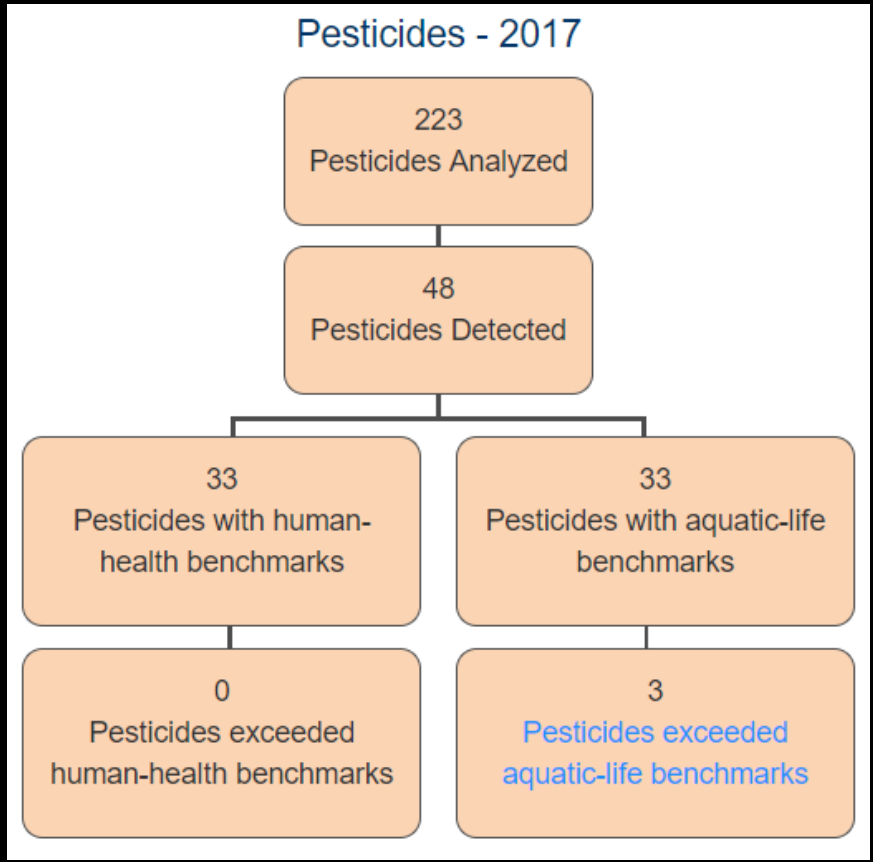
Ryberg et al., 2010

USGS

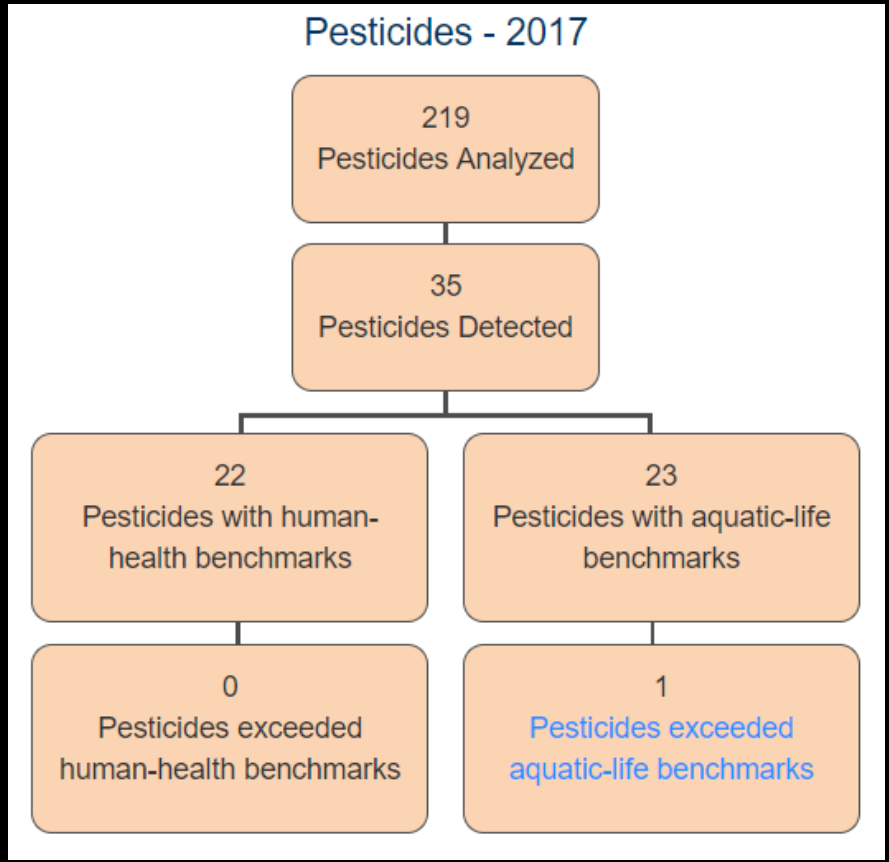
Pesticide Toxicity in Streams

Concentrations are generally low compared to human-health benchmarks, but more commonly exceed aquatic-life benchmarks

Accotink Creek, 62 km^2



Potomac River, 30,000 km^2



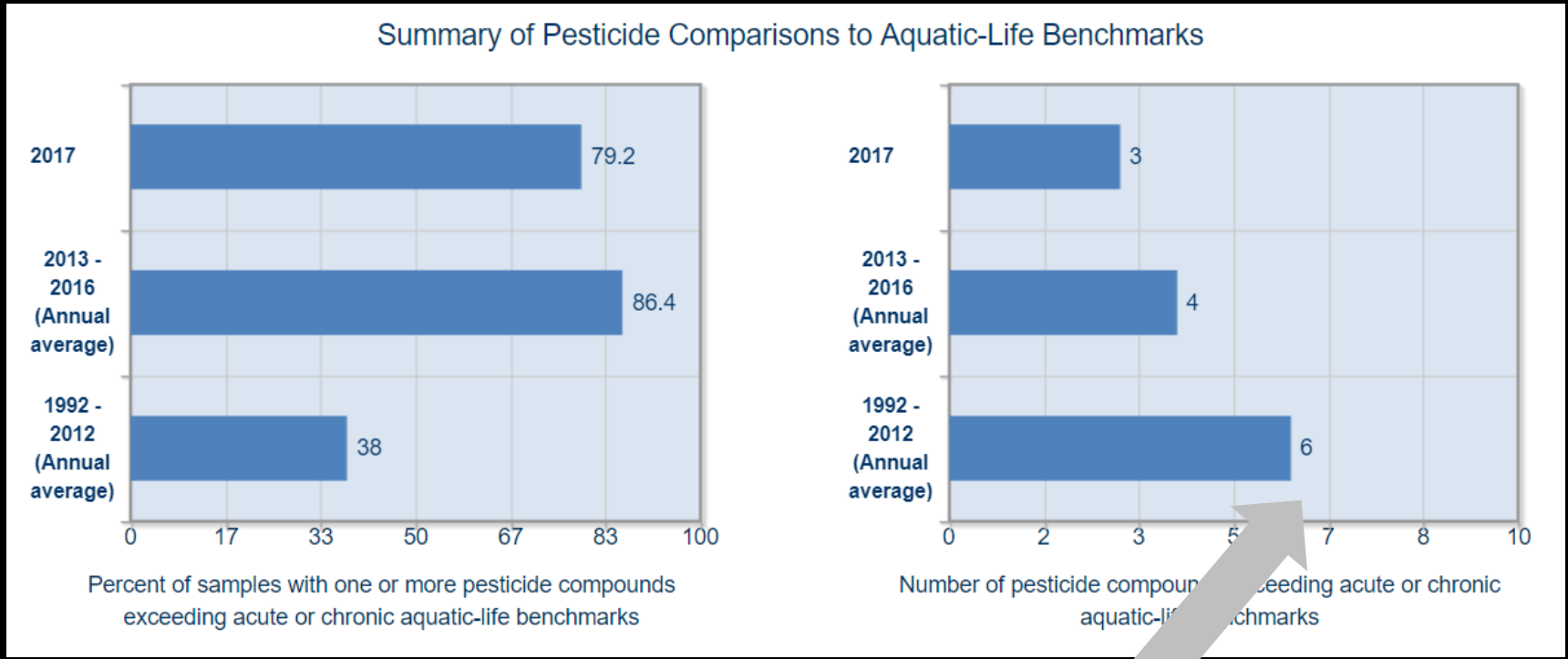
https://cida.usgs.gov/quality/rivers/home

USGS

Pesticide Toxicity in Streams

Accotink Creek, 62 km^2

Concentrations are generally low compared to human-health benchmarks, but more commonly exceed aquatic-life benchmarks in urban streams



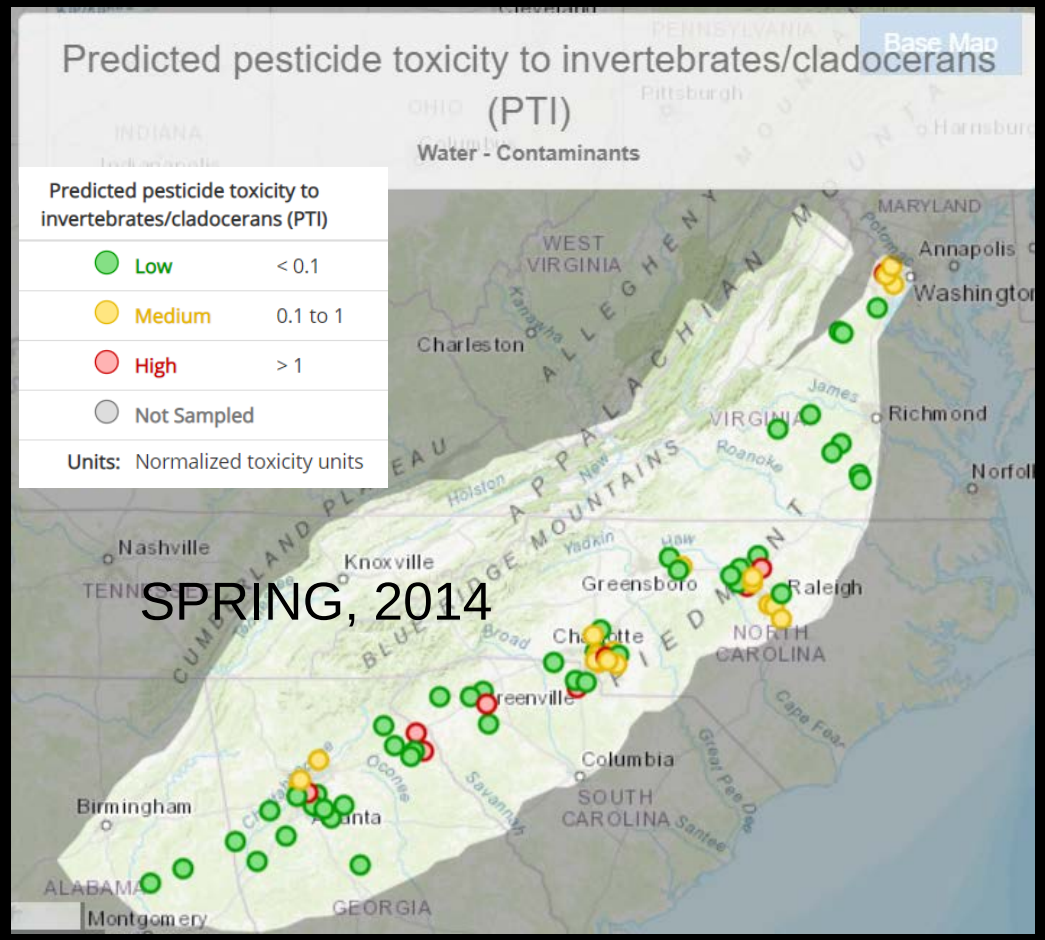
https://cida.usgs.gov/quality/rivers/home

Carbaryl, carbamate insecticide
Malathion, Dichlorvos, Diazinon, organophosphate insecticides
Fipronil, phenylpyrazole insecticide
Imidacloprid, neonicotinoid insecticide

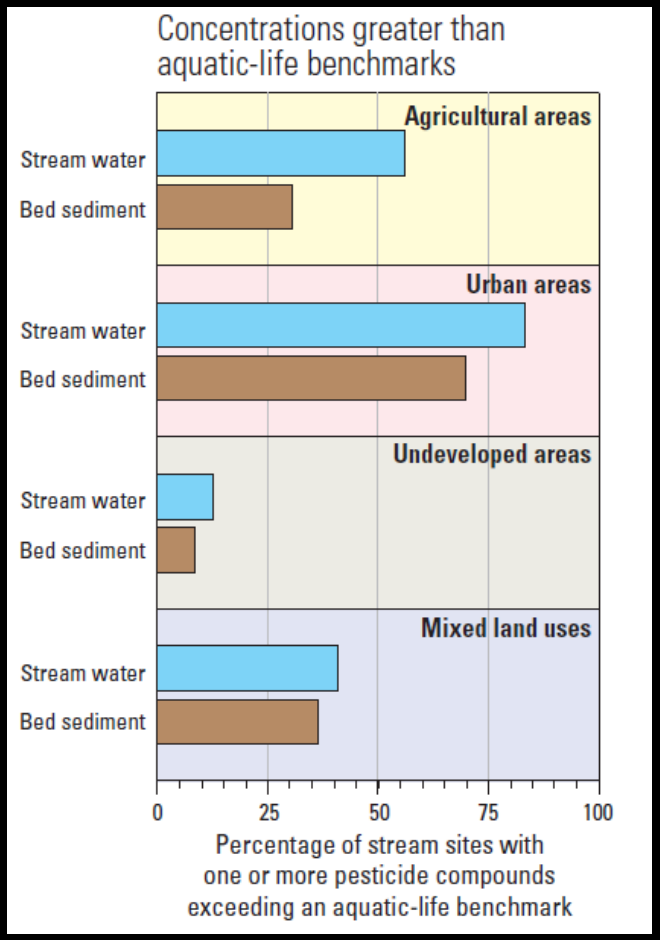
USGS

Pesticide Toxicity in Streams

Concentrations are generally low compared to human-health benchmarks, but more commonly exceed aquatic-life benchmarks in urban streams



http://webapps.usgs.gov/RSQA/

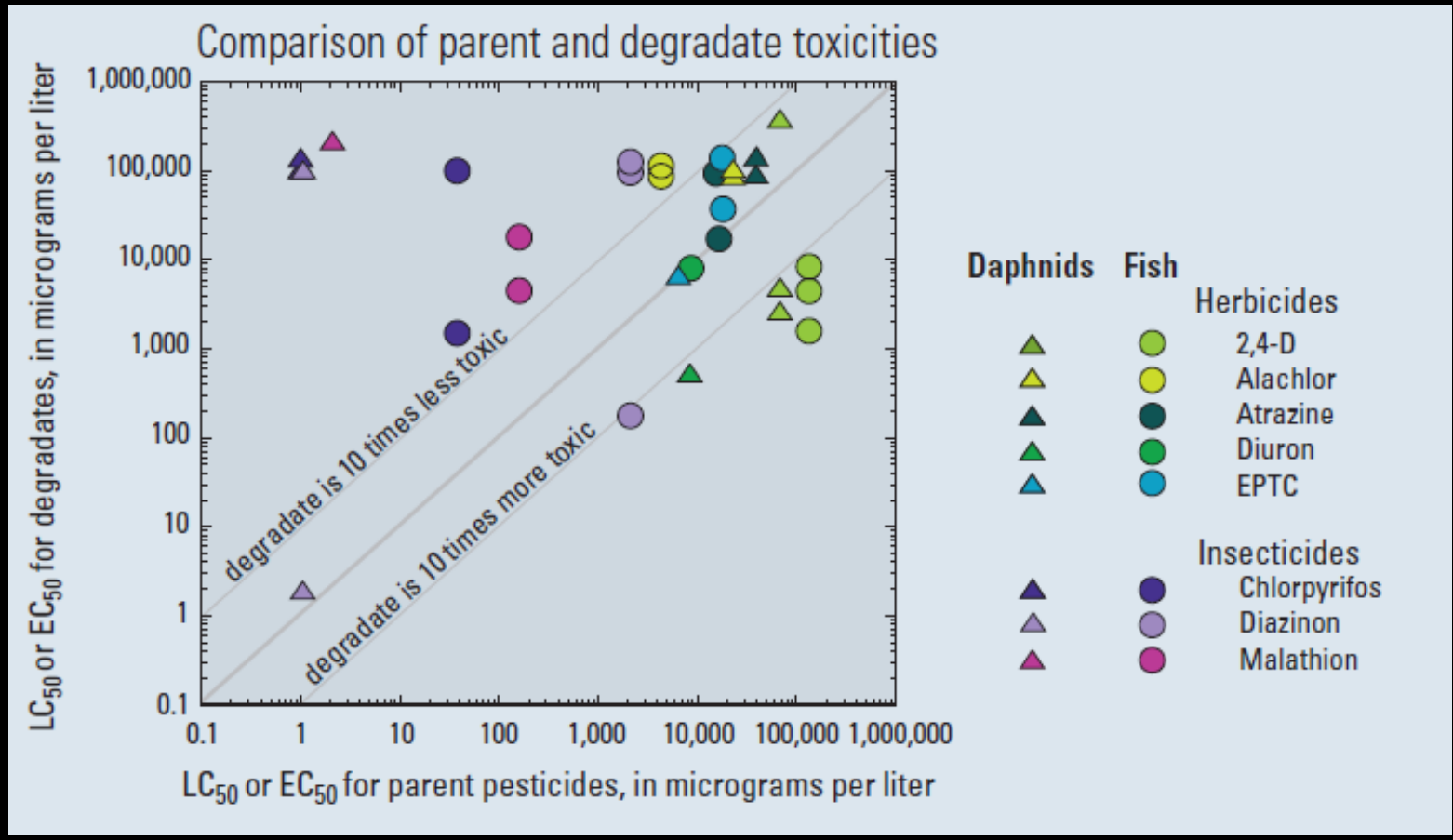


Gilliom et al., 2006

USGS

Pesticide Toxicity in Streams

Pesticide degradates may also be toxic to aquatic life

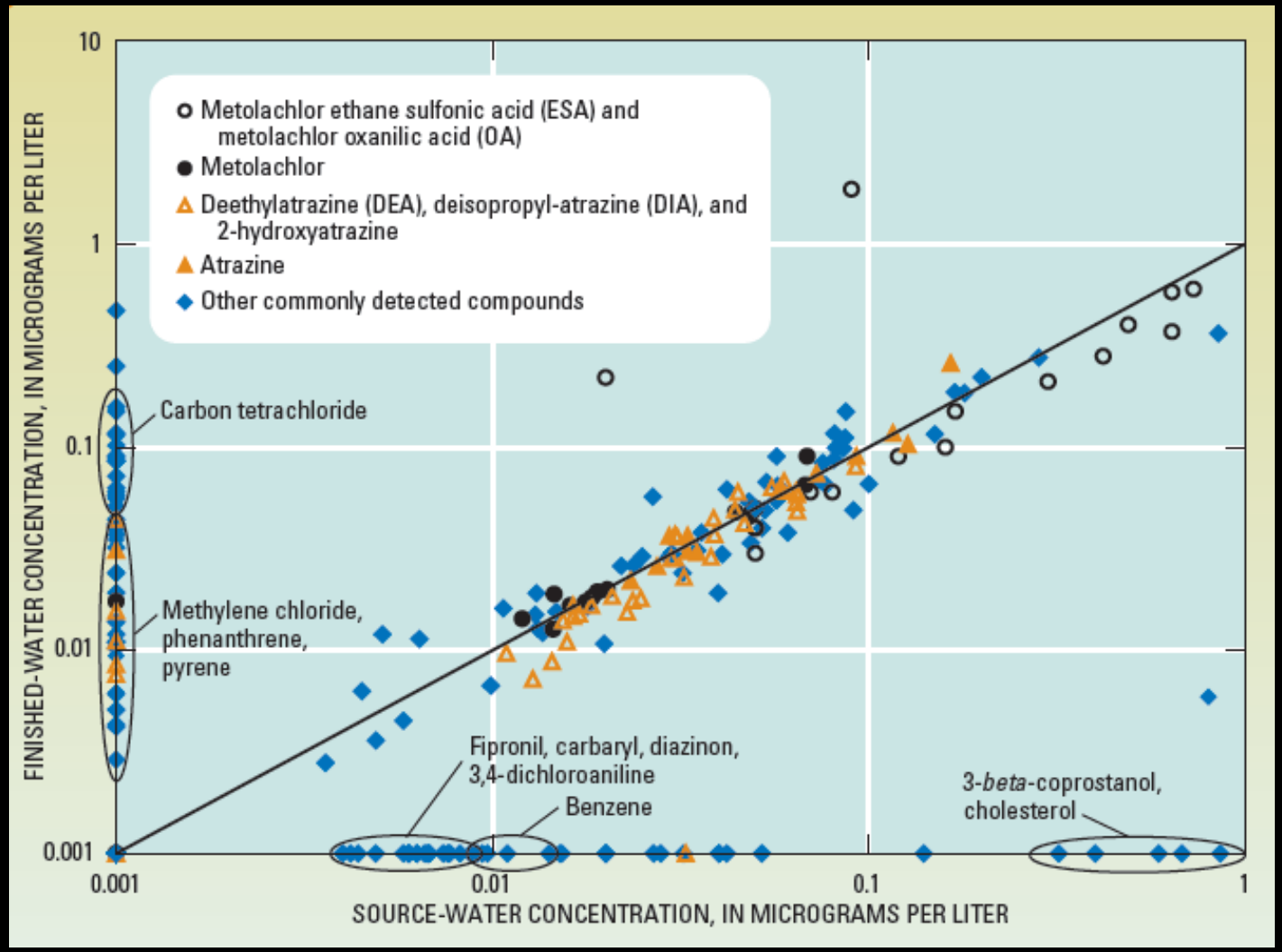


Gilliom et al., 2006

USGS

Pesticides and Drinking Water Treatment

Pesticides generally pass conservatively through water treatment



Brayton et al., 2008

USGS

Summary

- Pesticides and their degradates are common in streams near areas of use.
- Mixtures of multiple compounds are common.
- Herbicides are common in agricultural and urban areas, while fungicides and insecticides are more common in urban streams.
- Seasonal patterns and longer-term changes in concentration often reflect application practices.
- Concentrations are generally below human-health benchmarks but more commonly exceed aquatic-life benchmarks.

USGS