

# **Trends in Pesticide Detections and Concentrations in Ground Water of the United States, 1993-2003**

## **(Study Results and Lessons Learned)**

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# Study Objectives

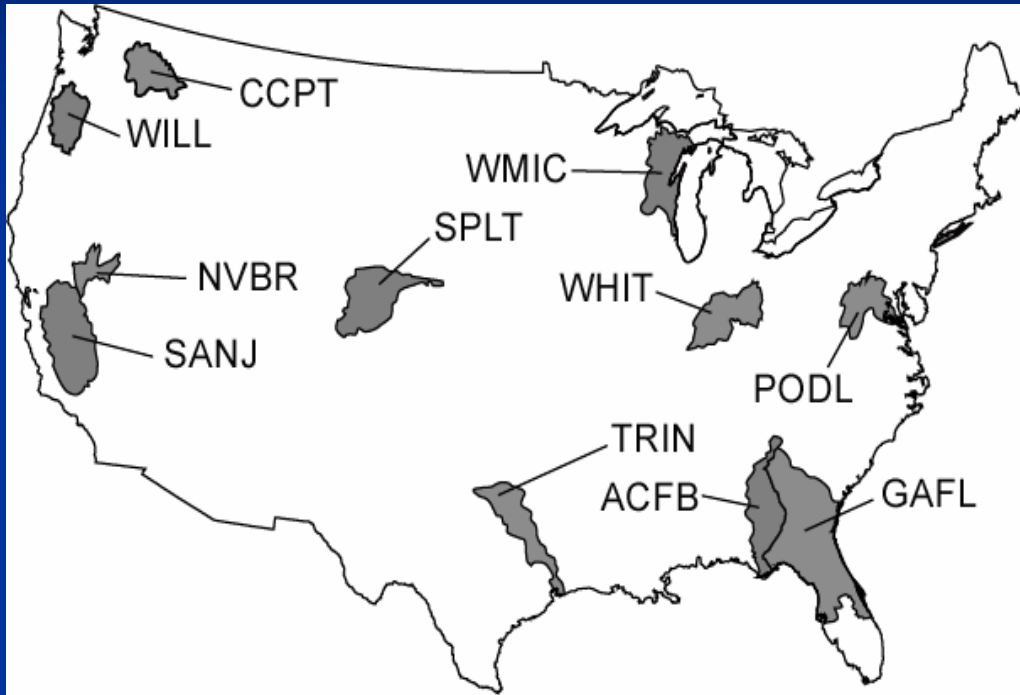
Broadly characterize near-decadal changes in pesticide detection frequency and concentration in ground water across the United States:

- Do we see trends in response to changes in chemical use and land-management practices?
- Over what time scales might changes in water quality be observed?
- Are particular pesticide compounds becoming more (or less) of a concern?
- Could the study design be improved?



# Characteristics of Dataset

## Study Units



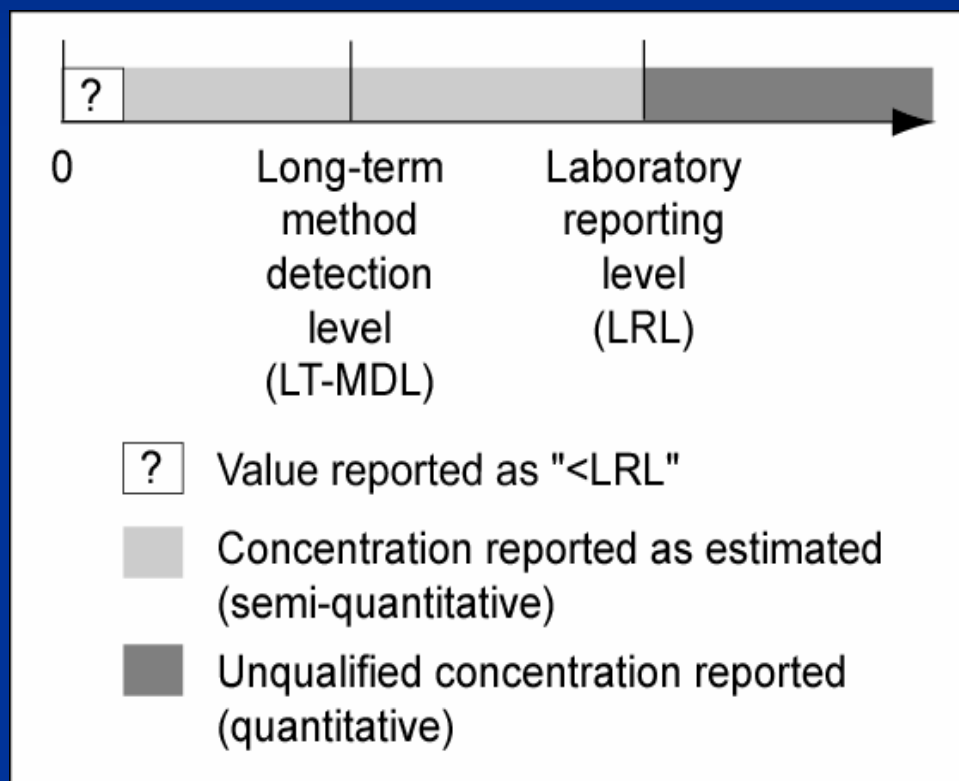
- 362 re-sampled wells in 11 Study Units
- Shallow wells in agricultural areas and deeper wells across variable land use
- Agricultural areas vary in hydrogeology and crop type
- Compared result from 1993-95 with result from 2001-03

Comparing 2 snapshots in time for about 100 compounds in ground water across a wide range of settings

# Issues Affecting the Dataset

# Laboratory Issues—Reporting Methods

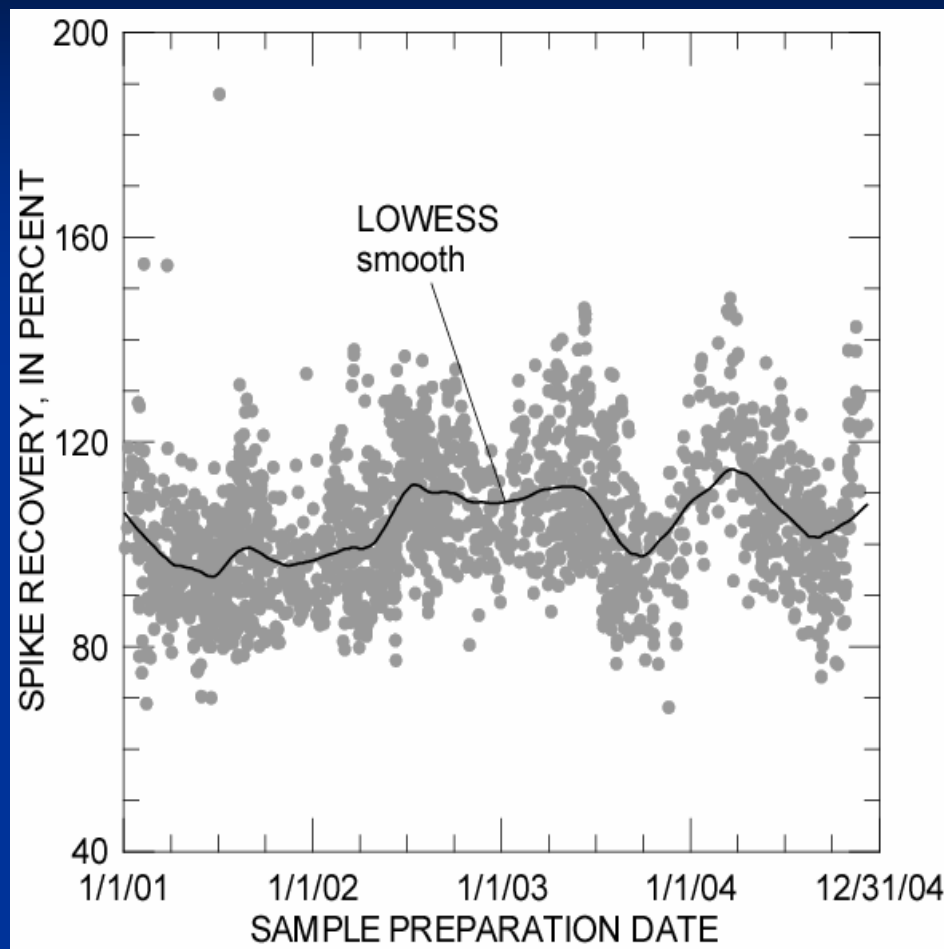
Analytical methods and laboratory reporting methods were consistent between sampling events



- Reporting method required “re-coding” of data to prevent bias
- Estimated values treated as quantified
- Non-detects treated as lower than estimated values
- Nonparametric statistics used
- Changing LRLs or LT-MDLs not a problem

# Laboratory Issues—Performance Changes

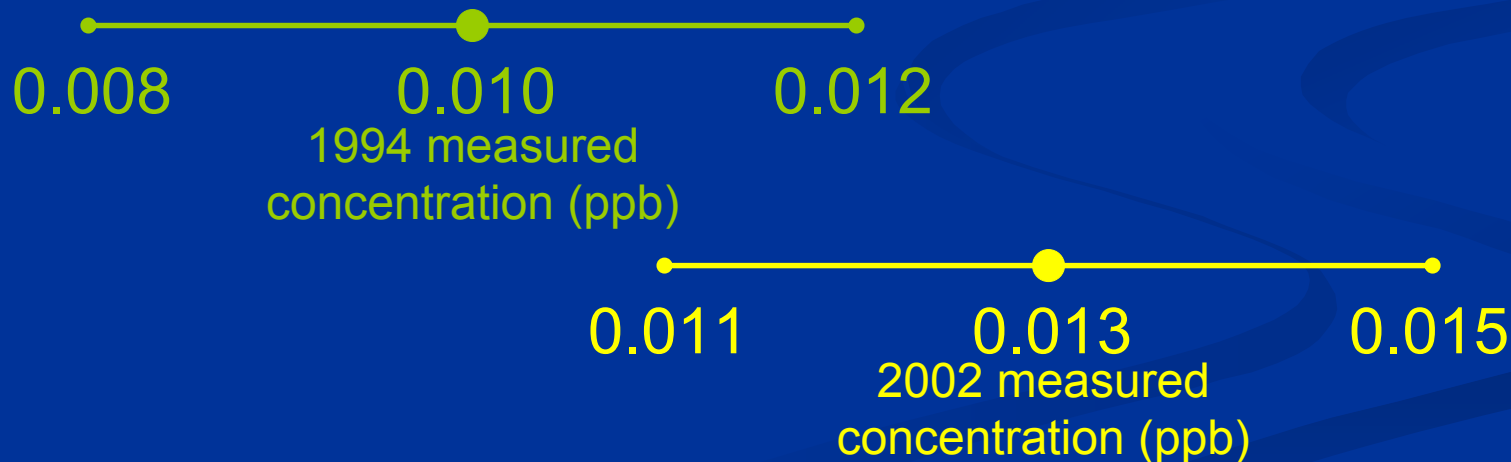
- Examined laboratory spike recovery data
- For most compounds, recoveries higher during the second sampling cycle
- Used a LOWESS smooth of spike data to recovery-correct concentrations



Changes in performance were large enough to affect results of trends analysis

# One More Issue—Inherent Variability

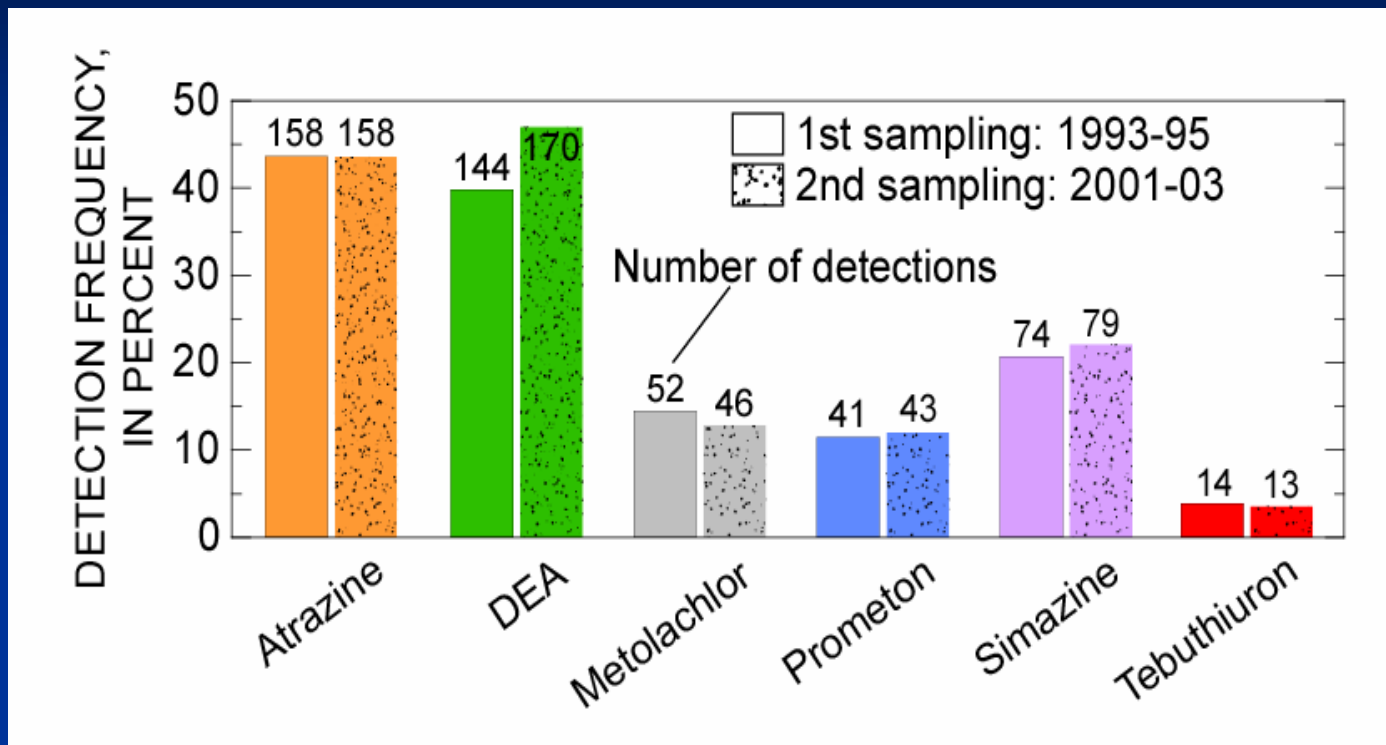
- Field replicates analyzed by Martin (2002) to quantify variability in field and laboratory procedures
- Information used to calculate 95% confidence intervals on concentrations
- Concentrations not considered different if 95% confidence intervals overlapped



# Study Results



# Most Frequently Detected Compounds

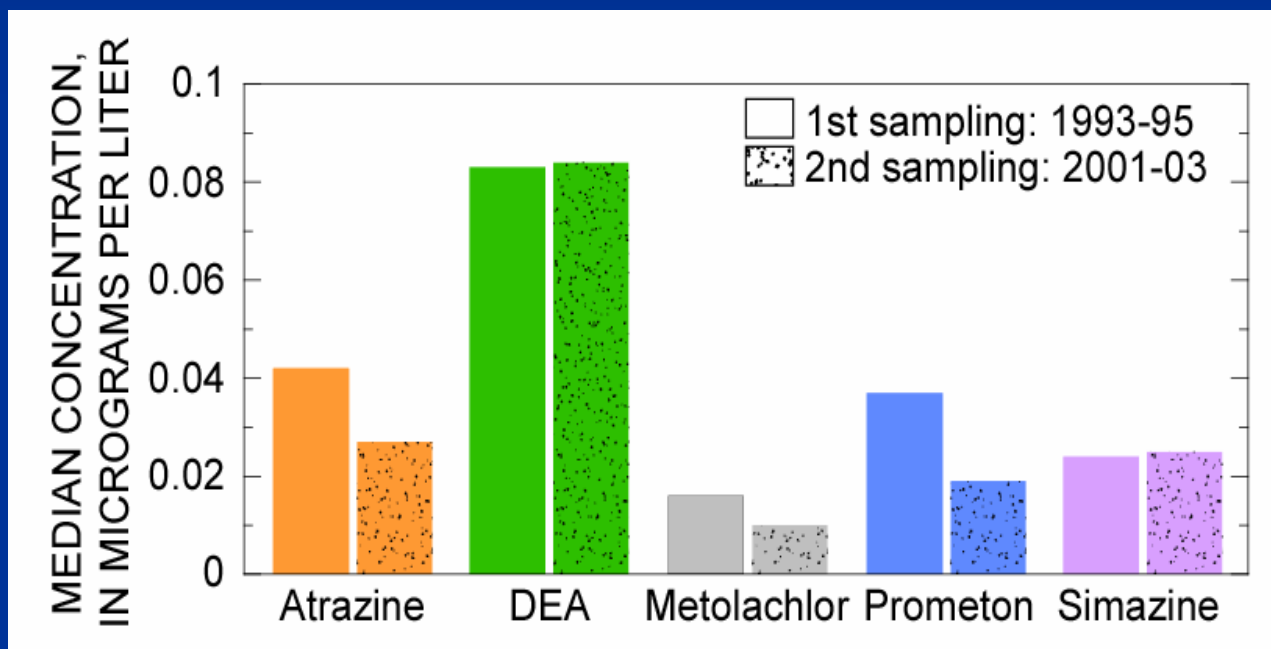


- Compounds have high use and/or high persistence
- Only DEA had a statistically significant change in detection frequency (real or lab recovery issue?)
- Changes in simazine and metolachlor use not evident

# Concentrations

Tested for trends in wells with detections during both sampling cycles

- Median concentrations very small



- Median changes in concentration less than 0.01 ppb, except for prometon (0.017 ppb)

# Results of Trends Analysis

- Sign test (a matched-pair test) used to investigate trends

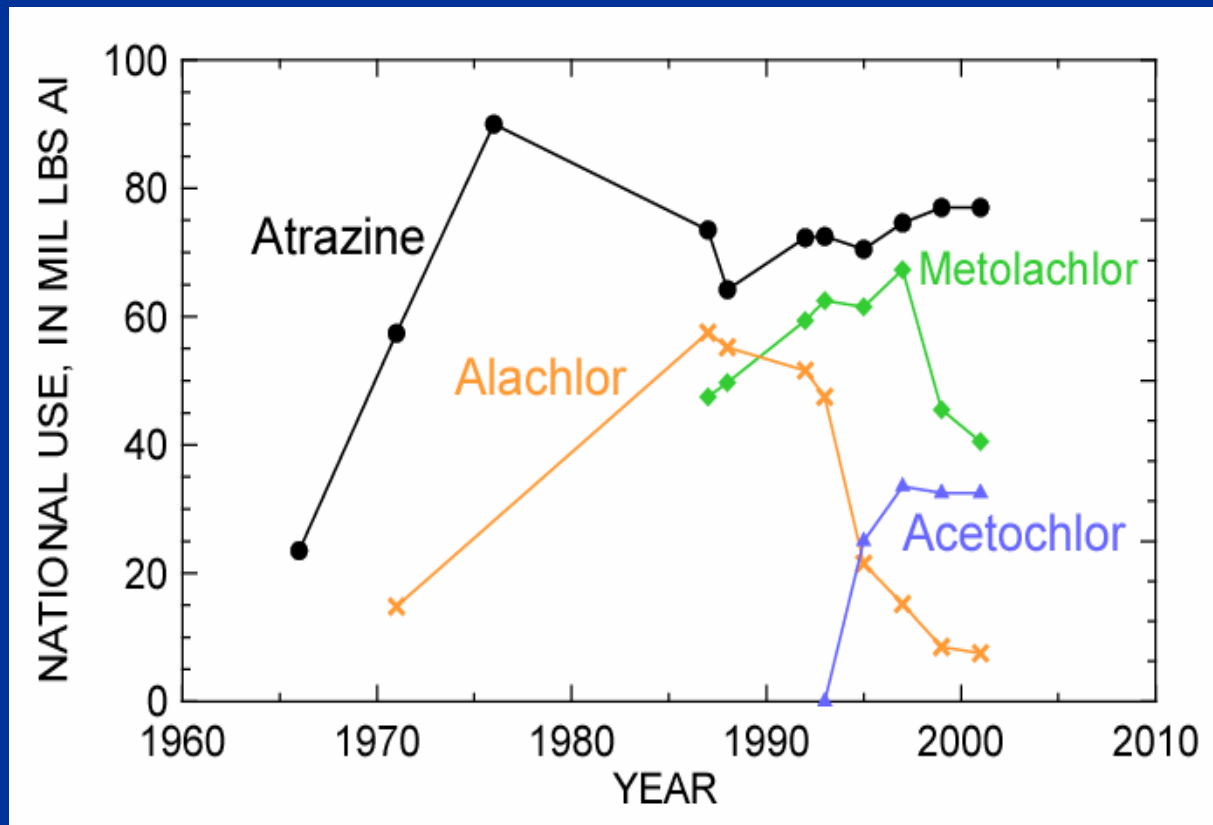
Compound	Recovery-corrected data with CIs*	Recovery-corrected data without CIs	Raw data with CIs	Raw data without CIs
Atrazine	--	↓	--	↓
DEA	--	↓	--	↑
Metolachlor	--	--	--	--
Prometon	↓	↓	--	↓
Simazine	--	--	--	↓

\* CI = confidence interval

- Most prometon detections in only 2 Study Units
- Changes in metolachlor and simazine use not evident

# Lessons Learned—Factors Affecting Identification of Trends

- Generally few detections and/or small concentrations
- Picture not complete without data for degradates
- Both timing and location of recharge are uncertain and variable across hydrologic systems



# Lessons Learned—Data Analysis

- Laboratory reporting methods must be carefully reviewed to avoid bias
- Changes in laboratory performance must be evaluated and accounted for quantitatively
- Variability inherent to reported concentrations must be evaluated and accounted for quantitatively
- Estimates of ground-water age facilitate analysis

# Summary of Study Results

- Compounds with largest use changes showed no National trends
- Small magnitude of potential trends indicate no pesticides becoming substantially more or less of a concern
- Cannot conclude whether trends would be clearer across a longer time scale
- Study design would benefit from greater knowledge of timing and location of recharge